

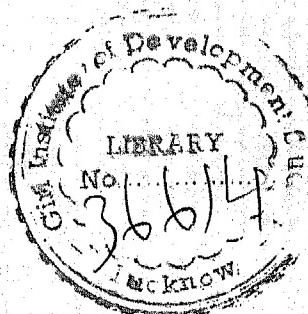
Economic Analysis And Growth Implications Of Expanding Sugar Output Through Alternative Technologies

**THESIS
SUBMITTED TO KANPUR UNIVERSITY
FOR THE DEGREE OF
DOCTOR OF PHILOSOPHY IN ECONOMICS**

**BY
RAKESH CHANDRA TYAGI**

8
338.14364
TYK
Agricultural production
sugar

*Under the Supervision of
Dr. G. P. MISHRA
Professor*



**GIRI INSTITUTE OF DEVELOPMENT STUDIES
LUCKNOW
1992**

गिरि विकास अध्ययन संस्थान
GIRI INSTITUTE OF DEVELOPMENT STUDIES

February 1992

CERTIFICATE

This is to certify that the enclosed thesis entitled "Economic Analysis and Growth Implications of Expanding Sugar Output Through Alternative Technologies" embodies the work of the candidate SHRI RAKESH CHANDRA TYAGI and that he worked under my supervision to complete his study for the period required under Ordinance 6. It is further certified that he has put in more than 200 days of attendance at the Giri Institute of Development Studies, a recognised centre for Ph.D. of the Kanpur University, to work under my supervision.



G.P. MISHRA
PROFESSOR

Forwarded

By Director
The Giri Institute of Development Studies
LUCKNOW.

DECLARATION

This thesis entitled 'Economic Analysis And Growth Implications of Expanding Sugar Output Through Alternative Technologies' embodies my original work for submission to Kanpur University, Kanpur, for PH.D. Degree. Further I declare that this work either in part or in full has not been submitted elsewhere for any degree or diploma or for publication.

Date : 11.2.92.

R.C.Tyagi

(RAKESH CHANDRA TYAGI)

PREFACE

The main problem in our state is how to absorb labour force in the industrial sector and create new employment opportunities, keeping in mind that the capital resources are limited in our country. Since the problem of unemployment continues to be a serious problem in Uttar Pradesh this study examines the economic implications of expanding sugar production capacity in the state by adopting OPS vis-a-vis VPS technology, also to find out which technology will improve employment situations effectively.

The work is completed under the supervision of Dr. G.P. Mishra, Professor, Giri Institute of Development Studies, Lucknow, to whom I am deeply indebted. In fact Prof. Mishra's expert advice, wise council and constant academic inspiration as well as creativity to me at this institute and incompletion of this study, his contribution is much too vital to be expressed in few words.

I am very grateful to Dr. B.K. Joshi, Director, Giri Institute of Development Studies, for providing institutional support and encouragement in completion of this study. I would like to extend my thanks to Dr. S.K. Goel, Director, ISID, New Delhi and Dr. G.S. Bhalla, Professor, J.N.U., New Delhi for discussions and suggestions on the various aspects of the subject which helped me a lot to shape my view and analytical expressions.

I am extremely grateful to Dr.D.S. Tyagi, Chairman, Commission for Agricultural Costs and Prices, Ministry of Agriculture, Govt. of India, New Delhi, whose help in completing this work has been much beyond his formal interest. Dr. Tyagi immensely helped me at the all stages in completion of this study. I sincerely believe that it would have been otherwise difficult for me to complete this study.

I am very grateful to my faculty members, Dr. A.Joshi, Dr. P.N. Pande, Dr. Y.P. Singh and my colleagues in the Giri Institute of Development Studies, Lucknow, Dr. G.S. Mehta, Dr. Fahim Uddin, Mr. Yaminul Hasan, Mr. D.K. Bajpai, Mr. B.K. Bajpai, Mr. P.S. Garia and Mr. S.D. Rai, have been quite generous in sparing their valuable time whenever I approached them for discussions and suggestions needed during the study.

My thanks are also due to Mr. Umesh Kumar Singh, Mr. Sunil Agarwal, Mrs. Usha Joshi and Mr. Ram Murthy, ISID, New Delhi for the computer work and handling the typing of this thesis efficiently at its various stages. My thanks to Mr. S.K. Ghosh, IIM, Lucknow, for the computerising the data.

I can not but express my sense of gratitude to the Indian Sugar Mills Association, whose publications have enabled me in obtaining the latest data and facts on the related topics.

(iii)

Finally, I thank to Mr. Farrukh Riaz, Librarian, ISID,
New Delhi, for giving assistance in library work.

R. C. Tyagi

Lucknow.

February 11, 1992

(RAKESH CHANDRA TYAGI)

C O N T E N T S

		Page
CHAPTER	1	Introduction
1.1		Development of Industries
1.2		Problem
1.3		Objectives
1.4		Hypotheses
1.5		Methodology and Scope
1.6		Data Required
1.7		Data Collection
1.8		Analysis
1.9		Selection of Sample
1.10		Bijnor - District Profile
1.11		Sugarcane Economy
1.12		The Plan of the Study
CHAPTER	2	Evolution and Development of Sugar Industry
2.1		Historical Background, Pre-colonial
2.2		Colonial Period
2.3		Sugar Industry in Free India
2.4		Present Position of Sugar Industry
2.5		Sugar Production Technology Employed
2.6		VPS Technology
2.7		OPS Technology
CHAPTER	3	Choice of Sugar Technology
3.1		Few Definitions of Technology
3.2		Sugar Processing Technologies
3.3		Juice Extraction Methods in VPS and OPS
3.4		Production Process of VPS

3.5	Production Process of OPS	89
3.6	A Review of Literature on Choice of Sugar Technology	92
3.7	Sugar and Khandsari Industry in Uttar Pradesh	106
CHAPTER 4	Future Scenario: Forecasts About the Industry	115
4.1	Trend of Sugar Production in India	115
4.2	Trend of Sugar Consumption in India	116
4.3	Per Capita Consumption of Sugar in Some Important Countries	119
4.4	Cyclical Trends in Sugar Production	122
4.5	The Changing Pattern of Demand	124
4.6	Trend of Sugar Production and Consumption in Uttar Pradesh	127
4.7	Forecasts about the Industry with Long-Term Perspective and Strategy	131
4.8	Forecast about Demand for Sugar and Sugar Production Capacity	134
4.9	Re-Assessment of Capacity	136
4.10	Recommendation - for 8th Five Year Plan	136
4.11	Need for Modernisation, Rehabilitation and Optimisation	138
CHAPTER 5	Capital and Labour Intensities	143
5.1	Fixed Capital	145
5.2	Working Capital	146
5.3	Classification of Labourers/Employees in Sugar Industry	149
5.4	Change in the Composition of Seasonal and Permanent Employees	153
5.5	Average Number of Employees Per Factory in Sugar Industry	153

(iii)

5.6	Supply of Labour and Methods of Recruitment in Sugar Industry	155
5.7	Employment in Two Sample VPS, Mills in Bijnor	157
5.8	Land and Building for OPS Units	159
5.9	Value of Plant and Machinery	161
5.10	Total Fixed Capital of OPS Units	162
5.11	Working Capital of OPS Units	163
5.12	Productive Capital of OPS Units	164
5.13	Capital Involved in Sample Khandsari Units in Distt. Bijnor	165
5.14	Employment Structure in OPS Units	165
5.15	Capital Efficiency of VPS and OPS	167
5.16	Comparison of Fixed Capital Costs in VPS and OPS	169
5.17	Labour-output Ratios for VPS and OPS	172
CHAPTER 6	Input Use Efficiency and Cost of Production	174
6.1	Cost of Production	179
6.2	A Comparison of Production Cost in VPS and OPS	184
6.3	Methodology to Calculate Social Cost	190
6.4	Investment Costs	194
6.5	Total Value of Output in Sample Units of VPS and OPS	197
6.6	Value Added	197
CHAPTER 7	Employment Implications and Evaluation of the Two Technologies	205
7.1	Employment Implications	206
7.2	Emoluments	212
7.3	Evaluation of the Two Technologies	215

CHAPTER	8	Summary and Conclusions	229
8.1		Summary of Findings	229
8.2		Methodological and Practical Implications in Technological Choice	231
8.3		Generalisation	236
8.4		Conclusion and Suggestions	237

LIST OF TABLES

	Page
Table 1.1 Number of Sugar factories (VPS) and Khandsari Units (OPS), Cane Crushed and Production in Five Distt of Western U.P.	18
Table 1.2 All India Acreage, Production and Yield/Hectare of Sugarcane	23
Table 1.3 All Uttar Pradesh Acreage, Production and Yield/Hectare of Sugarcane	24
Table 1.4 Area and Production of Sugarcane in Uttar Pradesh	26
Table 1.5 Area and Production of Sugarcane in Distt. Bijnor	28
Table 2.1 State-wise Total Number of Licensed and Installed Sugar Factories, In India (Position as on 30.9.89)	62
Table 2.2 Cane Crushed, Sugar Production and Sugarcane Prices Fixed in U.P.	68
Table 2.3 Total Cane Crushed, Recovery, Sugar Production, Duration and Crushing Capacity of Sugar Factories from 1971-72 to 1988-89 in India and Uttar Pradesh	69
Table 2.4 Can Crushed and Production of Sugar by Sugar Factories in Distt. Bijnor	71
Table 2.5 Value of Fixed and Working Capital, Total Employment, Value of Total Inputs and Outputs, Value Added and Value Added per Worker in Sugar Industry of U.P. and District Bijnor	74
Table 2.6 Value of Fixed and Working Capital, Total Employment, Value of Total Inputs and Outputs, Value Added and Value Added per Worker in Khandsari (OPS) Industry of U.P. Distt. Bijnor	75
Table 3.1 Comparative Data on Large-Scale and Mini Sugar Technology	104

Table 3.2	Comparative Analysis of the Productivity of the Two Technologies	104
Table 3.3	Total Number of Sugar Factories and Worked during 1950-51 to 1987-88 in Uttar Pradesh	107
Table 3.4	Sector-wise Distribution of Sugar Mills in Uttar Pradesh	106
Table 3.5	Sulphur and Non Sulphur Units of Khandsari in Uttar Pradesh	110
Table 3.6	Data Relating to Khandsari Units of Uttar Pradesh	112
Table 4.1	All India Production of Sugar (1950-51 to 1988-89)	117
Table 4.2	Per Capita Consumption of Sugar, Gur and Khandsari in India (1950-51 to 1987-88)	120
Table 4.3	Per Capita Consumption of Sugar in Some Important Countries	121
Table 4.4	Consumption, Export, Import of Sugar in India (1960-61 to 1988-89)	126
Table 4.5	Production and Consumption of Sugar in Uttar Pradesh (1976-77 to 1990-91)	129
Table 4.6	Projected Per Capita Requirement of Sugar, Gur and Khandsari in India (1990-91 to 2001-2002 A.D.)	133
Table 4.7	Projection for Sugar Production and Sugar Consumption in India (1990-91 to 2001-2002 A.D.)	133
Table 4.8	Projection for Demand and Installed Annual Sugar Production Capacity in India and U.P. (1990-91 to 200-2002 A.D.)	135
Table 5.1	Statewise Percentage Composition of Employees in Different Categories in Sugar Industry	151
Table 5.2	The Percentage Composition of Seasonal and Permanent Employees	152
Table 5.3	Average Number of Employees Per Factory	154

Table 5.4	Fixed Working, Productive Capital and Gross Value of Output in Two Sample Mills of Distt. Bijnor (1989-90)	157
Table 5.5	Employment Structure of Two Sugar Mills of Distt. Bijnor (1989-90)	157
Table 5.6	Distribution of OPS Units by Size of Land and Building in District Bijnor (1989-90)	160
Table 5.7	Distribution of Units by Size of Plants and Machinery in Bijnor (1989-90)	161
Table 5.8	Distribution of Units by Value of Fixed Capital in Bijnor (1989-90)	162
Table 5.9	Distribution of Units by Size of Working Capital (1989-90)	163
Table 5.10	Distribution of Units by Size of Productive Capital in Bijnor (1989-90)	164
Table 5.11	Capital Involved and Gross Value of Output in Sample OPS Unit of Distt. Bijnor (for the Year 1989-90)	166
Table 5.12	Employment Structure in Sample Units of OPS (workers in Distt. Bijnor (Year 1989-90)	168
Table 5.13	Value of Fixed, Working and Productive Capital per Worker and Sugar Output, Gross Value of Output Per Worker (Distt. Bijnor, Year 1989-90)	168
Table 5.14	Fixed Capital Cost (1989-90)	170
Table 5.15	Employment Per Unit Output in 1989-90	172
Table 6.1	Value of Total Input Use in Two Sugar Mills of Distt. Bijnor (1989-90)	181
Table 6.2	Value of Total Input Use in Ten Khandsari Units of Distt. Bijnor (1989-90)	182
Table 6.3	Levy Price for S-30 Grade Sugar (1985-86 to 1989-90)	186
Table 6.4	Particulars of Surveyed Units of Distt. Bijnor, Uttar Pradesh (1989-90)	187
Table 6.5	Cost of Sugar Production in Selected Units (1989-90)	187

Table 6.6	Per cent Recovery in VP and OP Units in Distt Bijnor, Uttar Pradesh (1989-90)	189
Table 6.7	Present Value of Costs in VPS and OPS (1989-90)	196
Table 6.8	Value of Total Output in Two Sugar Mills of Distt. Bijnor (1989-90)	198
Table 6.9	Gross Value of Output of Sample OPS Units in Distt. Bijnor (For the Year, 1988-89 and 1989-90)	198
Table 6.10	Value Added in Two Sugar Mills of Distt Bijnor (1989-90)	199
Table 6.11	Value Added for Ten Khandsari Unit of Distt. Bijnor (1988-89 & 1989-90)	201
Table 6.12	Value Added Per Employee and Value Added in VPS and OPS Units (1989-90)	202
Table 7.1	Distribution of OPS Units During (1977-78)	209
Table 7.2	Break-up of Employment in VPS and OPS Units	210
Table 7.3	Pattern of Employment in Selected Units of VPS and OPS (for 1989-90)	211
Table 7.4	Revised Wage Structure (1986)	213
Table 7.5	Comparative Wage Payments (1989-90)	214
Table 7.6	Open Market Wholesale	218

LIST OF GRAPHS

Graph I	Number of Sugar Factories in Uttar Pradesh (A Trend)	108
Graph II	Number of Khandsari Units in Uttar Pradesh (A Trend)	111
Graph III	Production of Khandsari Sugar in U.P. (A Trend)	113
Graph IV	Production and Consumption of Sugar in U.P. (Trend)	128
Graph V	Production and Export of Sugar from U.P. to Other States	130

LIST OF APPENDIX TABLE

	Page
Appendix Table 1 Sowing Season for Sugarcane in Different States of the Country	241
Appendix Table 2 List of Sugarcane Varieties Recommended for Commercial Cultivation for the Sub-Tropical Region of the Country During (1986-87)	242
Appendix Table 3 Value of Total Input Use in Two Sugar Mills of Distt. Bijnor (1989-90)	243
Appendix Table 4 Value of Total Input Use in Ten Khandsari Industry (OPS) in Distt. Bijnor	244
BIBLIOGRAPHY	249

CHAPTER 1

INTRODUCTION

In the economic life of India, Sugar Industry being the second largest organised industry next only to textiles, plays an eminent role. Since it is an agro-based industry located primarily in rural areas, it provides an effective instrument for carrying progressive trends in to the country side. This industry affects agricultural sector fundamentally and also affects all the persons in rural areas through backward and forward linkages significantly. Thus it forms a formidable base not only for developing the rural economy but the whole of the Indian economy. This is more true in respect of U.P. where the economy is dominated by the agriculture. Therefore, the expansion of sugar industry in India has tended to acquire the status of an indispensable factor for the upliftment of socio-economic, life of rural areas. In 1986-87 season, there were about 339 sugar factories, working in the country and out of these 101 sugar factories were working in the U.P. alone. On an averages, a sugar factory gets its cane supplies from 200 villages. Thus sugar industry directly influence economic activity in about 67,000 villages of the country.

These sugar factories developed from the process known as Khandsari process. From a long back white sugar has been manufactured by this process namely Khandsari. Khandsari units were traditional and producing powdery sugar of yellowish colour through a slow, laborious process. In this process, however, the recovery was very low. The traditional Khandsari process improved, between 1936-1948 and a new process was introduced known as Open Pan Sulphitation (OPS). This OPS process was better from traditional process of Khandsari, the recovery was higher than that in the traditional method and sugar was crystalline and white in colour. However, even today not all Khandsari units are producing crystal sugar as they are not using sulphitation process and their recovery is lower as compared to the sulphitation units. Even the sulphitation units are unable to produce the same quality of sugar or achieve the recovery levels as obtained by the modern sugar mills which works on the Vacuum Pan Sulphitation (VPS).

The development of this Industry has a direct bearing on agriculture as well as on employment. J.K. Mehta, renowned Economists says "Take care of your agriculture and your Industries will take care of themselves".¹ Sugar Industry has the great potentiality in providing employment both direct and

1. Prof. Mehta J.K., Economic Problems of Modern India, Allahabad p. 141.

indirect. With the rapid growth in population, the major problem that India faces today is that of unemployment. Hence in planning for development of any industry apart from other conditions its employment generation potential should be one of the important consideration.

1.1 Development of Industries in relation to Employment:

Industrial distribution of employed population remaining almost unchanged despite targets of growth for the industrial sector being achieved in successive five year plans in India, had led many to realise that the growth in the GDP per say is not capable of solving the problem of unemployment and poverty at its own. Now, it is recognised that for solving the problem of unemployment, it would be necessary to adopt a policy to make the pattern of production more labour intensive and to regulate technological changes so that the rate of growth of employment is maintained at a satisfactory level along with a policy to maintain the highest feasible rate of growth. To quote Sixth Plan. "It has generally to be realised that the concept of growth rate of economic development has considerable limitations. It is unrelated to the national income distributed over different classes, while it is true that a more rapid expansion of the economy will generally make it easier to increase the welfare of poor, it is not necessary

that the allocation of resources require to reach the highest achievable rate of growth of economy at any point of time will be optimal from the point of view of the desired distribution of income".

If there is no technological change in a particular sector, employment in that sector would grow at the same rate as output. If one wants greater labour absorption, employment must grow at faster rate than output for which adoption of labour intensive technology may be necessary. Employment oriented strategy by altering factor intensities in production is likely to change income distribution and consumption pattern of people. As the structure of aggregate demand determines product mix of the output, the question of size of income transfers from the rich to poor and that of demand pattern for additional output to be produced by labour intensive technology become critical importance. On the other hand, the efficiency in the use of raw materials from alternative technologies and linkages that would emerge between various sectors through the adoption of a particular type of technology are also of importance. The choice thus has wider implication than provision of more jobs. The economic objective of any production process is to satisfy the country's demand for goods and services and also add value which gets reflected in National Income, employment

generation policies are followed as they help in transferring income from haves to the have-nots.

In developed countries, employment is not taken in to consideration as an aspect of performance of industrial sector, but it is important specially in developing countries. Employment depends on the techniques of production in an Industry, and improvements in this often leads to a reduction in employment, but improved techniques not only brings about increased production but also efficiency. These positive aspects thus have to be weighed against reduction in employment.

In a developed country, where the means of production are sufficient for full employment of existing resources including labour, the choice of technique can be primarily on the basis of efficiency in a developing country like India where the means of production in general are in short supply and insufficient to employ fully the available labour, the employment aspect of performance assumes greater importance. The slogan of walking on both legs may be translated as "maximum possible economy of investible resource to secure a desired growth of output and this entails the maximum possible increase in employment per unit of investment", thus becomes of relevance too.

If industrialisation is attempted by imitating or transplanting mechanised methods of production in the

name of modernisation, it certainly could increase employment but the increase could be far less than what would have been possible if a policy of investment on the Chinese principle was adopted. Whether it reduces employment absolutely would depend on the extent to which mechanisation is carried on. Installation of productive capacity of advanced technology also involves advanced methods of organisation of business and training of personnel in properly using such techniques. While it normally would increase the flow of physical output and sales value, it may add 'to squalor and smog', as some sceptic but practical observers would put it. When this takes place with sufficient rapidity, it is likely to add to employment as well.

The choice between the two aspects of an investment namely improved modern technology and employment, is not an easy one; while import saving investment increases employment in the country, mechanisation of home industry in itself tends generally to reduce it. One aim of investment is to increase productivity while the other is to provide employment. The dilemma can be resolved only by the adoption of a rational plan for industry where a balance between the maximum feasible increase in productivity and efficiency on the one hand and the level of actual employment on the other is maintained. In practice it means that in fields like heavy

industry and long range transport where capital/labour ratio is high, much gain in productivity can be achieved by mechanisation and that should be the plan. But in consumer goods industry where mechanisation is a substitution of small scale production, the objective should be to postpone it until employment situation looks up i.e. to widen the stock of means of production rather than "deeper" it in marxist terminology certainly despite all the fanfare of industrialisation, it could hardly make a dent in the field of employment. This relates to the whole economy. So there is an urgent need to find out as to how can one increase job opportunities in industrial sector. Sugar Industry is largest consumer goods industry and a technological choice between large capital intensive sugar mills and medium capital saving and labour intensive technique - Sulphur Khandsari (OPS) or mini sugar mill can be made, an ideal choice for a study.

At the time of formulation of the Draft Sixth Five year plan the implication of adopting alternative technologies in the case of few selected industries were examined. In the case of production of white sugar (VPS) the implication of adoption of Open Pan System (OPS) popularly known as Khandsari units vis-a-vis Vacuum Pan System (VPS) was studied mainly from the point of view of capital requirement and labour intensities of the two technologies. The average cost

of production in OPS sector (Rs. 4098 per tonne) was found to be higher by 26 per cent than in the VPS (Rs. 3254 per tonne), when Rs. 700 per tonne was taken in account for quality preference in the cost of OPS Sugar. Without this adjustment average cost of OPS (Khandsari) Sugar was found to be higher than the cost of VPS Sugar only 4 percent. Khandsari units require nearly half of the capital as compared to mill sugar (VPS) but created four times employment per tonne as compared to VPS mill, although they payed half the daily wage as compared to VPS mills.

In the studies undertaken on behalf of the planning commission, two important aspects were completely lost sight of. The flexibility in the operation particularly to the farmer relating to the timing of harvest of the crop that becomes available in the OPS was not taken in to account. Moreover, the implication that the adoption of OPS would have on the competitive strength of the Indian Sugar in the International market was also not considered. These studies were taken as case studies and implication of adopting alternative technologies in the frame of a long term growth prospective were not attempted.

In India the domestic consumption of sugar between 1960-61 and 1987-88 have grown at a rate of 5.6 percent per annum. Keeping in view the rise in population, the growth in the GDP and demand elasticity for sugar it is projected by 2000 A.D., the

total requirement of sugar for domestic consumption would be of the order of 165 lakh tonnes and if export requirement of 10 to 15 lakh tonnes is considered it would become 180. Thus it would be necessary to increase the production capacity of white sugar from the present level of about 85 lakh tonnes to about 180 lakh tonnes and above.

1.2 Problem:

Uttar Pradesh is the biggest state of India with 11.09 crores of population according to the census 1981. The population of Uttar Pradesh is now increasing more than 25 lakhs per year and labour force increasing about 10 lakhs per year. The number of registered unemployed in the state increased by 7 lakhs during 1985 and is going on increasing. The backlog of unemployment was estimated to be at 21 lakhs at the end of Sixth Plan and may be about 30 lakhs at present. Now the main problem in our state is how to absorb labour force in the industrial sector and create new employment opportunities, keeping in mind that the capital resources are limited in our country. Since the problem of unemployment continues to be a serious problem in U.P., this study examines the economic implication of expanding sugar production capacity in the state by adopting OPS vis-a-vis VPS technology also to find out which technology will improve employment situations effectively.

1.3 Objectives:

Uttar Pradesh accounts for 54 per cent of area under Sugarcane in the country and for 45 per cent of Sugarcane production. Assuming that Uttar Pradesh would maintain its share in the total sugar production of the country in future also the net addition to the production capacity during the next decade would work out 30 lakh tonnes. This apart the fact that a large number of Sugar Mills in U.P. are fairly old and many of these units have gone sick, would suggest that net additional requirement of expansion of Sugar production capacity in the state would be much higher. In any case in these sick units large amount of capital investment would be necessary for modernisation and renovation. On the other hand the alternative technology available for the production of Sugar consistent with desirable capital employment parameters shows that future demand for sweetening agents, after allowing for fuller utilisation of the existing and licensed sugar mills can be met by necessary expansion through Open Pan Sulphitation (OPS) plants. Keeping in view the problem of unemployment in the state and the feasibility of choosing between technologies of sugar production the study was taken with following as the main objectives:-

- (1) To estimate capital and labour intensities of Vacuum Pan Sulphitation (VPS) and Open Pan Sulphitation (OPS).
- (2) To examine the efficiency of input use in the two systems.
- (3) To study the behaviour of cost of production of sugar in the two systems.
- (4) To examine the variation in the value added by the two production processes, and
- (5) To study growth implications over a period of 15 to 20 years of adopting OPS vis-a-vis VPS for augmenting production of white sugar.

The first objective of the study will show that how much difference between VPS and OPS systems of producing sugar in respect of capital requirement and labour absorption. It will also require estimation of the capital, labour ratio in the vacuum Pan Sulphitation and in Open Pan Sulphitation. The second objective is concerned with the growth of efficiency of input use in the Open Pan Sulphitation and Vacuum Pan Sulphitation. A feature which has been highlighted by various studies is the wide divergence in the costs of manufacturing sugar in large sugar mills. Variation in plant sizes and quality of management have been found to significantly contribute to the divergences in cost of manufacturing sugar. The scope of third objective is to study the differences in the manufacturing costs of both VPS and

OPS units. The fourth objective of the study will show the total value of output produced by these units and input costs which reveal value added in Khandsari units and the large VPS units and will find out the variation in the value added by these two production processes. The last objective will study the growth implication over a period of 15 to 20 years of adopting OPS vis-a-vis VPS for augmenting production of white sugar.

1.4 Hypotheses:

A few relevant hypotheses for each of the objectives mentioned above are spelled out at appropriate place in the discussion. An attempt has been made to verify these hypotheses in a systematic way.

1.5 Methodology and Scope:

In the following pages a detailed description of the procedures adopted to achieve the objective of the study is being given. However, the description is not exhaustive in the sense that the limitations arising from any particular procedure followed and the merits and demerits of a particular procedure vis-a-vis any other alternative procedure do not form part of the present description, although, these have been pointed out and highlighted at the relevant places in the subsequent chapters.

1.6 Data Required:

Both primary and secondary data would required to achieve the above objectives. For the secondary data, published matter by the Indian Sugar mills Association, Indian Sugar Year Book, Annual Survey of Industries, Co-operative Sugar year book etc. would be made use of. For this purpose, some data has now been collected from official agencies like Directorate of sugar and vanaspati of Government of India, Assistant cane and sugar commissioners office, State Planning Institute, Co-operative sugar federation. The information available on different aspects of the two technologies from National Sugar Institute has also been used. Primary data for the study has been calculated from two sugar factories and ten Khandsari units.

1.7 Data Collection:

Primary data, obtained by carrying out a field survey of Distt. Bijnor. Data pertaining to various variables such as size of capital involved, regular and temporary employment, details of production, expenditure pattern and details of sugarcane crushed, were collected by canvassing a comprehensive and well structured schedule. The schedule was divided in to three parts, each part dealing with a particular category of information.

(a) Part One: In this part, information pertaining to general information about the unit (mill) i.e. name and address of the unit, year of establishment and whether registered under the factory Act or not (in case A OPS units), Details about the Entrepreneur/Partner and Background of Entrepreneur/Partner were collected.

(b) Part Two: In this part, information about the capital structure involved in the production unit and employment structure were collected both from the VPS and OPS units selected for the study.

(c) Part Three: In this part, there were question seeking information regarding the details of input use in money term, Details of sugar cane crushed, value of total output or details of Production and expenditure pattern or total input use. Difficulties and problems faced by the entrepreneurs were also asked in the last part of the questionnaire.

1.8 Analysis:

Analysis of the economics of sugar production through the two systems of producing sugar i.e. V.P.S and O.P.S in Uttar Pradesh. The following tools are used for the calculation of various factors in the two systems of sugar production:

(1) For the computing the compound growth rate and estimation of the demand of sugar in the future the following equation has been used:

$$r = \left[\text{AntiLog} \left(\frac{\sum \log P_t - \sum \log P_0}{\sum t} \right) - 1 \right] \times 100$$

where:

$$\sum \log P_t = \log X_1 + \log X_2 + \log X_n$$

$$\sum \log P_0 = n \times \log X_1$$

$$\sum t = n(n-1)/2$$

r = Compound Growth Rate.

$$(2) \log y = a + b^t$$

where:

a = Constant term

b = Regression Coefficient

t = time or Number of Years

y = Final figure

$$(3) M_t = M_0 (1 + r/100)^t$$

where:

M₀ = Base year

r = Growth rate

t = Time or number of years

M_t = Final figure

For the computing the 'Real opportunity costs of production of both technologies the following equation has been used:

The real opportunity costs of production by either technology have a Present Value -

n Ct

$$(4) \quad PV(C) = \sum_{t=0}^n \frac{C_t}{(1+i)} + I.P_t$$

where:

C_t = Total running costs.

I = Initial Capital investment requirement.

P_t = The shadow price of investment funds.

i = Social rate of discount.

Estimation of the shadow price of investment the following formula has been used:

$$(5) \quad P_t = r (1-a)/(i - ar)$$

where:

a = rate of re-investment of profits.

r = rate of return on investment in the economy.

i = Social rate of discount.

1.9 Selection of Sample:

Area: The main purpose of the study is to examine the economic implication of expending Sugar production capacity in the U.P. State by adopting OPS vis-a-vis VPS Technology and to find out that which technology is suitable among OPS and VPS in the existing conditions like severe unemployment, lack of capital and high incidence of poverty. In the selection of area for the study, the choice would certainly fall on an area in which number of Sugar Mills (VPS) and number of Khandsari units (OPS) are quite large. There is a high concentration of the OPS units in the

districts of Bijnor, Moradabad, Muzaffar Nagar, Meerut and Saharanpur all in western Uttar Pradesh. All these five districts are also having three to seven big sugar mills (VPS). The total number of Sugar mills (VPS units), cane crushed by them and sugar production and also the total number of Khandsari units (OPS units), number of working units, cane crushed by them and Khandsari Sugar production OPS units are given in (Table No. 1.1).

Since it is clear from the table 1.1, that the district of Bijnor has the largest number of OPS units not only in Western uttar Pradesh but also in entire Uttar Pradesh and also has sufficient number of Sugar mills both in Public and Private Sector. The importance of Bijnor for the Khandsari Industry is evident from the large number of juice boilers that travel from here to the other districts and even to other state to work in the Khandsari factories. The District Bijnor this can be considered to be the best choice for a study looking at the comparative economics of two processing sectors.

1.10 Bijnor - District Profile:

The district is situated about 150 Km north-east of New Delhi.

It covers an area of almost 5,000 Km² and had in 1981 a population of 19,39,000, which implies a population density of 400/Km².

Table No. 1.1

**Number of Sugar factories (VPS) and Khandsari Units (OPS),
cane crushed and Production, in five Distt. of Western U.P.**

District	Year	No. of VPS units	Cane Crushed by VPS units (Lakh Qt.)	Sugar production by VPS units (Lakh Qt.)	No. of OPS licenced units	No. of OPS working units	Can Crushed by OPS units (Lakh Qt.)	Khandsari Production by OPS units (lakh Qt.)
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
1. Bijnor	1987-88	4	235.03	21.25	197	168	190.27	7.90
	1988-89	4	176.43	17.18	194	178	181.12	7.37
	1989-90	5	286.92	25.82	193	181	185.82	7.04
2. Moradabad	1987-88	3	65.56	5.42	289	267	199.11	9.11
	1988-89	3	55.99	5.13	280	250	180.44	8.41
	1989-90	3	97.11	8.16	263	237	187.15	8.33
3. Muzaffar Nagar	1987-88	5	229.87	19.88	152	143	125.04	4.40
	1988-89	5	190.40	18.26	144	137	126.73	5.14
	1989-90	5	268.67	24.10	132	130	109.13	4.01
4. Meerut	1987-88	7	299.45	34.83	207	192	166.24	6.21
	1988-89	7	187.24	23.55	195	181	148.61	6.41
	1989-90	7	297.58	36.63	174	168	150.81	6.01
5. Saharanpur	1987-88	6	260.17	23.00	150	133	92.47	2.98
	1988-89	6	188.53	17.32	143	134	88.98	2.90
	1989-90	6	303.44	27.47	136	134	78.67	2.55

Source: Cane Commissioner's office, Lucknow.

The 1981 census gave the following information with respect to Bijnor. The proportion of the population living in urban areas amounted to 24.79 percent and was distributed over 19 towns of which the district headquarter Bijnor, was the largest with 56,713 inhabitants. Out of a total of 3,055 villages, only 2,102 were inhabited. The majority of the population, (59.15 percent) is Hindu, while the Muslims are a sizeable minority 36.66 percent. The population increased by 25.1 percent, during the period 1961-71. During this period population had increased of 19.8 percent in the state of Uttar Pradesh as a whole. During the next decade 1971-81 the increase in the districts population was 30.14 percent which also exceeds the increase of 25.49 percent for the state of Uttar Pradesh as a whole. During 1971-81 no significant changes took place in the structure of the labour force. The population of cultivators in the labour force declined only marginally at 45 to 43 percent. The percentage of agricultural workers also remained almost at the same level as in 1971, where as during the period 1961 to 1971 it had increased dramatically from 9 to 23 percent. The percentage of workers outside agriculture slightly increased from 31 to 34.03 percent. The literacy rate during 1981 was 26.71 percent, which was more or less the same as the average of the state.

The dominant economic activity out side agriculture is sugarcane processing. There are five sugar factories located at Bijnor, Dhampur, Chandpur, Seohara and at Nijibabad. Three of these five were established shortly after the Sugar Import Control Act, 1932 got enforced. The Bijnor mill, after a prolonged period of sickness, was placed under the control of the State Government. The Seohara mill belongs to the Birla group and was, until 1985-86, the largest mill with Bijnor district, with a licensed crushing capacity of 3600 tonnes per day. In recent years, the Dhampur factory has expanded rapidly and has become leader in district with a capacity of 5,000 tonnes per day. Dhampur factory, which is in private sector belongs to Goel group. The chandpur mill belongs to the Uttar Pradesh State Sugar Corporation and it started crushing sugar cane from the 1977-78 season. It's capacity was 1,250 tonnes per day. This has been increased to 2,000 tcd. in 1985-86 and further 4,000 tonnes per day in 1988. The number of OPS plants amounted to 281 in the 1980-81 season and another 168 licensed units manufactured Gur and non sulphur Khandsari. Further, a large number of bullock driven crushers, known as 'Kolhus', produced gur partly for the farmers own consumption and partly for sale.

For detailed study two VPS units were selected. One unit was in private sector and second was under

the public sector management (U.P. State Sugar Corporation Ltd). Ten Khandsari units have been taken for primary survey.

1.11 Sugarcane Economy:

Sugarcane is the main raw material of Sugar Industry. The cost of sugarcane accounts for about 70 percent of the cost of sugar production. Sugar industry is one of those industries which fully depends on agriculture. It is, therefore, necessary that adequate quantity and high quality of sugarcane supplies are available to mills in a regular process. The production of sugarcane like other agricultural commodities is subject to the vagaries of nature and that extent working of sugar mills is beset with uncertainty.

The area under sugarcane, its production and yield per hectare had shown an upward trend during the period 1950-51 to 1987-88 in the country. However, there had been variations in both area under cane and production from year to year. For example while the yield per hectare during three years period from 1975-76 to 1977-78 increased about 5.5 tonnes. The yield per hectare declined to 49.1 tonnes in 1978-79 and 49.4 tonnes in 1979-80 due to unfavourable weather conditions. The yield per hectare in 1980-81 again increased to 57.8 tonnes and to 58.4 tonne during 1981-82. The yield per hectare was 56.4 tonnes in

1982-83, 56.0 tonnes in 1983-84, 57.2 tonnes in 1984-85, 59.9 tonnes in 1985-86, 60.4 tonnes in 1986-87 the highest even achieved so far due to favourable weather condition at the time of sowing and also during the growth period, like the year 1981-82 and 59.9 tonnes in 1987-88 respectively. (Table 1.2)

In Uttar Pradesh the production of sugarcane, its yield area showed an upward trend since 1950-51. From a period 1975-76 to 1977-78 the area of sugar cane increased from 1441 thousand hectare to 1637 thousand hectare and production rose 58359 thousand tonnes to 76819 thousand tonnes respectively. The highest ever achieved so far in sugarcane area, sugarcane production and in yield was the year 1987-88, were the area was 1807 thousand hectare, production was 93350 thousand tonnes and yield was 51.66 tonnes (Table 1.3)

Sugarcane is an important cash crop of the state. It grown extensively in the western, central and Eastern parts of the state. In the year 1988-89 the total area under sugarcane was 1761 thousand hectare and the total irrigated area under sugarcane was 1464 thousand hectare. The five district of western U.P. namely Bijnor, Moradabad, Meerut, Saharanpur and Muzaffarnagar together accounted for nearly 44 percent of the area covered under sugarcane and their share in total production of sugarcane was around 49 percent. This primarily answers the question as to why there is such a heavy concentration of Khandsari units in

Table 1.2

All India Acreage, Production & Yield/hectare of Sugarcane

Season (1)	Area (000 hectares) (2)	Production (000 tonnes) (3)	Yield per hectare (in Tonnes) (4)
1950-51	1707	69920	41.0
1955-56	1846	72692	39.4
1960-61	2513	110544	45.8
1965-66	2836	123990	43.7
1970-71	2615	126368	48.3
1975-76	2772	140604	50.9
1976-77	2866	153007	53.4
1977-78	3151	176966	56.2
1978-79	3088	151656	49.1
1979-80	2610	128833	49.4
1980-81	2667	154248	57.8
1981-82	3193	186350	58.4
1982-83	3357	189505	56.4
1983-84	3110	174076	56.0
1984-85	2953	270319	57.2
1985-86	2859	174365	59.9
1986-87	3979	170648	60.4
1987-88	3287	196723	59.9
1988-89	3373	204626	60.7

Source: Indian Sugar Year Book 1984-85 & 87-88 & 89-90.

Table 1.3

All Uttar Pradesh Acreage, Production & Yield/hectare of Sugarcane

Season (1)	Area (000 hectares) (2)	Production (000 tonnes) (3)	Yield per hectare (in Tonnes) (4)
1950-51	1014	40030	39.47
1955-56	1101	40537	36.81
1960-61	1329	54516	41.02
1965-66	1490	56650	38.02
1970-71	1345	54672	40.64
1975-76	1441	58359	40.49
1976-77	1456	65215	44.79
1977-78	1637	76819	46.92
1978-79	1634	62324	38.14
1979-80	1373	51228	37.31
1980-81	1363	64205	47.10
1981-82	1660	76440	46.04
1982-83	1783	81387	45.64
1983-84	1688	78244	46.35
1984-85	1536	70888	46.15
1985-86	1490	73058	49.03
1986-87	1678	84736	50.49
1987-88	1807	93350	51.66
1988-89	1779	89371	52.20

Source: Indian Sugar Year Book 1984-85 & 87-88 & 89-90.

western parts of the Uttar Pradesh. Mostly Khandsari units are good in shape of production found in Bijnor District. As district Bijnor, selected for the study out of above five districts it has been found that in term of yield rates, the district Bijnor has a much higher yield rate as compared to the state as a whole. The 1989-90 figures show an average yield of 55.3 tonnes per hectare for the state, while in Bijnor district much higher yield 57.9 tonnes per hectare. (Table 1.4)

The Sugarcane cultivation in the state seen in terms of total area under sugarcane shows a fluctuating trend. In the year 1974-75 the total area under sugarcane was 1491 thousand hectares which worked out to be 8.68 percent of the net area sown in the state. The year 1980-81 witnessed the least area under sugarcane cultivation (1363 thousand hectares) and was only 7.91 percent of the net area sown. The highest figure of 1800 thousand hectares was achieved during the year 1987-88 and this was 10.50 percent of the net area sown. While the figures of the area show fluctuations over the years the figures relating to average yield by and large show an increasing trend except for a couple of years in between. Thus the yield in tonnes per hectare went up considerably from 41.2 in 1974-75 to 55.3 by the year 1989-90. (Table 1.4)

Table 1.4

Area and Production of Sugarcane in Uttar Pradesh

Year	Net area sown (000 ha.)	Net Irrigated area (000 ha.)	Total area under sugarcane (000 ha.)	Total irrigated area under sugarcane (000 ha.)	Production of sugarcane (000 Ton)	Average Yield (Tonnes/ha.)
(1)	(2)	(3)	(4)	(5)	(6)	(7)
1974-75	17160	7793	1491	1067	61479	41.2
1975-76	17201	7933	1440	1036	58359	40.5
1976-77	17375	8260	1455	1100	65215	44.8
1977-78	17421	8493	1636	1267	76818	46.9
1978-79	17481	8892	1633	1236	62324	38.1
1979-80	16997	8912	1372	1041	51228	37.3
1980-81	17221	9453	1363	1088	64204	47.1
1981-82	17288	9541	1651	1346	76440	46.4
1982-83	17226	9884	1782	1392	81386	45.6
1983-84	17273	9879	1388	1315	78243	46.3
1984-85	17248	10154	1543	1231	70888	46.1
1985-86	17243	10132	1489	1211	73036	49.0
1986-87	17232	9854	1680	1384	84736	50.5
1987-88	17135	10043	1800	1488	93054	51.7
1988-89	N.A.	N.A.	1761	1464	88522	50.3
1989-90	N.A.	N.A.	1755	N.A.	97127	55.3

Source: Cane Commissioner's Office, Lucknow.

The area under sugarcane as a percentage of net area sown in District Bijnor was as high as 31.51 percent in 1974-75 and went up to 49 percent by the year 1987-88. This is the district which has experienced minimum fluctuation in its area under the sugarcane between the years 1974-75 and 1989-90. However, the Bijnor district has had considerable fluctuations in the yield rates of sugarcane over the same period of time (Table 1.5).

Planting Time of Sugarcane:

The Planting time of sugarcane varies from place to place which itself is dependent upon the climatic conditions. The planting time varies with the type of cane crops to be taken. The planting period is generally so selected as the soil temperature remains around optimum and there is neither drought nor water logging in the field. In Uttar Pradesh, the cane crop is planted mainly in the month of October-November and February-March and the time is adjusted according to the local conditions. The sowing seasons for sugarcane in different states of the Country is given in the Appendix Table 1.

Main Varieties of Sugarcane:

There is a great requirement of new varieties of sugarcane capable of resistance to the diseases and their availability. It has been suggested that Zonal

Table 1.5

Area and Production of Sugarcane in Distt. Bijnor

Year	Net area sown (000 ha.)	Net Irrigated area (000 ha.)	Total area under sugarcane (000 ha.)	Total irrigated area under sugarcane (000 ha.)	Production of sugarcane (000 Ton)	Average Yield (Tonnes/ha.)
(1)	(2)	(3)	(4)	(5)	(6)	(7)
1974-75	311	134	098	065	5024	51.26
1975-76	316	142	097	067	4446	45.83
1976-77	338	162	104	079	4736	45.53
1977-78	344	167	130	100	7112	54.70
1978-79	348	180	135	100	5707	42.27
1979-80	344	192	119	092	4675	39.28
1980-81	345	198	125	102	6262	50.09
1981-82	345	196	124	099	5393	43.49
1982-83	346	206	150	120	7583	50.55
1983-84	348	203	148	116	7282	49.20
1984-85	344	214	141	109	6714	47.61
1985-86	343	216	136	113	7416	54.52
1986-87	342	222	152	127	7929	52.16
1987-88	339	236	166	140	8823	53.15
1988-89	N.A.	N.A.	160	138	8583	53.64
1989-90	N.A.	N.A.	173	N.A.	10024	57.94

Source: Cane Commissioner's Office, Lucknow.

Research Stations should be set up preferably one in each region consisting of a number of sugar mills.²

In order to increase sugarcane yield, sugar recovery and sucrose content a list of suitable varieties of sugarcane has been recommended for commercial cultivation in the subtropical regions during 1986-87 as shown in Appendix Table 2. This list is a list of suitable cane varieties recommended in the Indian Sugar Year Book 1987-88.

The main varieties of sugarcane grown in the sample district - Bijnor are B0-38, B0-48, B0-58, B0-54, B0-67 and B0-70. Although these different varieties of sugarcane have been considered suitable for the purpose of manufacturing sugar but the B0-48 variety is considered to be much more superior variety of crop since it contains a higher quantity of juice and hence facilitates higher juice recovery as compared to the other varieties mentioned above. There is, however, no difference in the prices paid by the mills for different varieties. The minimum price to be paid by sugar manufacturing unit is arrived at on the basis of the previous years recovery percentage.³

2. Report of the Cane and Sugar Development Committee (Bihar) 1965, p 15.

3. Tyagi, D.S. "Farmer's Response to Agricultural Prices in India; A Study in Decision Making". Delhi (1974), p.49.

Despite the great demand of BO-48 variety it is not grown over a larger area because it requires higher number of irrigation. As a result even in areas where it can be grown its cost of cultivation is slightly higher as compared to other varieties. The cultivators, therefore, are growing other varieties of sugarcane which can be grown with relatively ease and at lower cost. The other factor is that the yield per hectare, BO-48 is lower than that of other varieties. Yet another disadvantage of BO-48, is that it is less resistant to bad weather conditions and being soft it can be easily eaten up and damaged by animals.

1.12 The Plan of the Study:

The study has been divided into eight chapters, each of which discusses one specific issue. A brief resume of each chapter is given below:-

CHAPTER 1:

First chapter introduces the problem under investigation, specifies the objectives of the study and the methodology adopted for the study. It also gives an idea about the area for the primary survey and about the main input used i.e. sugarcane in the two systems of sugar production i.e. VPS and OPS in brief.

CHAPTER 2:

Explain the present status of the sugar industry and production technology employed in it. Also throw light on historical background of sugarcane and sugar industry and discusses the present position of this industry and its development after independence.

CHAPTER 3:

Defines the various technologies and critically surveys the existing literature on choice of sugar technology and points out the important gaps therein.

CHAPTER 4:

The chapter examines the trend of Sugar Production and consumption in India and Uttar Pradesh and Forecasts about the sugar industry with a long term perspective. Also estimates the demand for sugar and sugar production capacity for India and Uttar Pradesh.

CHAPTER 5:

Examines the capital intensities and labour intensities in the two techniques of producing crystalline sugar i.e. in modern sugar mills and improved Khandsari units. It also describe the forms of capital and types of workers and other staff required for these two production techniques.

CHAPTER 6:

Analyses the merits and demerits of the two technologies of sugar production i.e. OPS and VPS, on the basis of comparative costs of production and input use efficiency.

CHAPTER 7:

Evaluate two technologies of VPS and OPS, and examines that which is more suitable for employment generation and in Indian economy where capital is scarce and labour is surplus. Also examines that role the OPS sector should play in the future development of the sugar industry.

CHAPTER 8:

Brings together the important conclusions that can be drawn from this study.

CHAPTER 2

EVOLUTION AND DEVELOPMENT OF SUGAR INDUSTRY

Sugar Industry is one of the major industries in India. Although, modern sugar factories started in the first decade of 19th century, with one factory each being set up in Uttar Pradesh and Bihar, but when one goes carefully through the history of sugar manufacturing, than it is evident that India is the original home of the sugarcane as well as sugar manufacturing. The modern mill industry had a striking growth as a result of the imposition of protective import duties from 1932. While in 1932 there were only 32 factories in the country, in next five years the number of factories increased to 137 and production went up seven times to nearly one million tonnes pushing India to the top among in sugar producing countries. It was producing about 6.7% of the total world output but has been now surpassed in annual production only by countries like USSR, Cuba, USA and Brazil. So it is important to know, first, about the history of the sugar, sugarcane and sugar industry before looking in to the present status of the sugar industry and production technology employed.

2.1 Historical Background, Pre-Colonial:

Sugar has been known to India for about 2000 years and there is ample evidence to show that India is the original home of sugarcane as also of sugar manufacture. Sugar has been mentioned in the epics as one of the five Amritas i.e. celestial sweets. Nothing tastes so sweet as sugar. Even the english term sugar is a derivative of the Sanskrit word 'SARKARA'. The world 'Shakkara' was in vogue in Prakrit literature for sugar. Therefore, its mention is found in many language with different names varying in pronunciation. It has been mentioned as 'Schakar' in Persian, Sukkar in 'Arabic', 'Suicar' in Assyrian, 'Saccharum' in Latin 'Azucar' in spanish and Portuguese, 'Zuhero' in Italian, 'Sucre' in French, 'Zucker' in German and so on. Mention about sugarcane is found in the Artharva Veda in 5000 B.C. There is perhaps no earlier description of sugarcane than this in the hoary history of the world. References of sugar are found long ago in the institutes of Manu and the treatises of Charaka and Susruta dealing with medicine. Its mention in the records of Megasthenes and in Arthashastra of Chanakya is also traced back to the period 321-296 B.C. Alexander, the great and his soldiers were the first foreigners (Europeans) to find sugarcane in India when they came over to this country in 327 B.C.¹ A chinese encyclopaedia written about

1. Indian Sugar Supplement, 1940. p. 10.

the middle of the 16th century mentions that in India the art of sugar making has reached such a high standard that the Chinese Emperor TAI TSUNG (627-650 A.D.) sent his men to learn the method of sugarcane cultivation and manufacture of sugar. In fact, India is the birth place of the manufacture of sugar from sugarcane juice.

A close study of the literature of the Mohammedan period reveals that first class white sugar was produced from 'Gur' throughout Northern India specially in Burdwan and Murshidabad divisions in Bengal up to Gorakhpur in Oudh before the advent of the British². In the past India enjoyed monopoly in the world from the new point of view both sugar production and sugar supply. Indian sugar used to pass through the famous caravan routes of Khaiber and Bolan Passes. Sugar from India used to be shipped to Genoa, Venice and many other countries first jolt in 1,453 when the Turks captured Constantinople and demanded heavy tributes on sugar passing through the city. This trade had to face a second jolt with naval blockade of the British which caused hindrance to France in getting sugar from India. Consequently on the initial and sponsoring of Napolean, France succeeded in the production of sugar out of sugar belt. This was followed by bounties which subsidised

2. Gandhi, M.P., The Indian Sugar Industry. Its Past, Present and Future (Calcutta 1934), p.2.

sugar export trade from almost all the west European countries. This gave a serious blow to the Indian sugar trade. The Indian market was thus dumped by very cheap sugar produced in Java and other countries.

Historically it is said that the modern process of sugar manufacture was introduced in the west as early as in 1853 but the same process came to India as late as in about 1903 when the first sugar factory with Vacuum pan process and modern milling method was commissioned in saran at Marhowrah in Bihar in 1904. It is said that less than three hundred years ago, the mass of the people scarcely tasted sugar. Sugar was the rarest of luxuries and was even steemed as a medicine. But Gongetic India had long known the sugarcane and the art of boiling sugar from it. Evidently the chinese acquired the knowledge about it from India in the first half of the seventh century. It was the Arabs who finally brought the practical art of cultivation of sugarcane to the knowledge of western Europe. It was the great age of discovery by the Portuguese and spaniards which carried the cultivation of sugarcane around the world. Sugarcane was planted in Madeixa in 1420. It was carried into Santo Domengo in 1494. Early in the sixteenth century it spread to the West Indies and to the other parts of

South America. In the year 1700 only ten thousand tonnes of sugarcane came to Great Britain³.

It is evidently obvious that it is from India that cane-sugar (sucrose) that is universally used as an essential consumption good spread to other countries. From India, the growing of sugarcane and its use in the making of sugar spread to China, Ceylon and Java to Persia in the sixth century and to Spain in the eight century. In the course of their conquests from the seventh to the ninth centuries, the Arabians introduced the growing of sugarcane and the manufacture of sugar in to cyprus, Egypt, North Africa, Spain and Sicily. The cultivation of sugarcane was promoted in all the tropical colonies of the European Nations after the discovery of America. It spread to Cuba in 1511, Maxico in 1522. Portorico in 1523, Jamaica in 1527, and Peru and Brazil at about the same time. In 1751, the Jesuits introduced the cultivation of sugarcane in to Louisiana which later on became the principal North American producer of raw sugar⁴.

Sugarcane (*Saccharum Officinarum*) is a native of southern Asia first grown in India. During the later middle age, it was grown in the countries around the

3. The World's Sugar Supply: Its Sources and Distribution, National Bank of Commerce, December 1917. pp 7-8.

4. Gustav Mikusah, Sugar: Encyclopedia of the Social Science, Vol. XIV (The Macimillan Company, New York). pp. 450-455.

Mediterranean, from the Mediterranean the crop spread rapidly westward, first to the Island off the American coast, then to the newly discovered American countries. Thereafter, cane sugar ceased to be a luxury and became an article of common consumption all over the world. Hawaii, Puerto Rico, Peru, Brazil and Argentina are the producers of sugarcane in Western Hemisphere. The Philippines, Formosa, Queensland in Australia, and the Indian ocean islands of Mauritius are commercial producers of sugar in the eastern Hemisphere. One of the important contributions to world production is India. India outranks Cuba from the viewpoint of quantitative volume of production.

Ibn-i-Batute during his travel in India in 13th century has greatly admired sugarcane grown in India in his 'Safarnamah'. There is a specific reference to the Paunda cane of the Malabar coast therein. There is a good description of the method of sugarcane cultivation making of all forms of sugar and distillation of spirits from it in the Aim-i-Akbari.⁵. Munshi Sabhan Rai of Patiala (1695) gives interesting description of sugarcane in his 'Khulastu-i-Tawarikh Sher Ali Afsos (1804) mentions in his 'Araish-i-Mahfil'. Currently accepted classification of the sugarcanes of upper India during the 17th century.

5. Van Royen and Bengtson Fundamentals of Economic Geography', V.Edition (Prentice Hall of India, Pvt Ltd., New Delhi, 1969), pp 152-156.

Thus it admits of no doubt that India is the original home of sugarcane and sugar in view of the aforementioned facts of historical records.

2.2 Colonial Period:

The historical development of modern sugar in India is amply demonstrated by the authentic accounts of Mr. Minden Wilson about several indigo concerns in his Reminiscence of Bihar (1887) when had came to calculate in 1847. In fact, the history of sugar in the remote past is romantically intermingled with the history of indigo and saltpetre⁶.

In 1877, a very black cloud hung over the indigo industry. Towards the end of the 19th century indigo cultivation began to decline due to cheap synthetic indigo entering into world market, the introduction of aniline dyes and the conservent fall in the price of indigo as explained by Licutenal Governor of Bengal, Shri Ashby Eden. According to him factories grew indigo side by side with sugarcane but valuable 'seeth' (refuse) a very useful manure was neglect. There are evidence in the documents of 1793 and thereafter to show that almost all the indigo factories in Tirhut were spoken of as being sugar and salt petre as well as indigo 'manufactories'. The cause of the abandonment of sugar industry after 1849-

6. Minden Wilson, History of Bihar Indigo Factories, Reminiscences of Bihar (The Calcutta General Printing Company 1908) pp. 6-64

50 was the high prices of indigo and the dye. Similarly before sugar was started in 1845, price of indigo were at a very low ebb.

In 1791, the massacre of almost all the white population in the black rebellion in Hayati and San Domingo made the largest producers and exporters disappeared, consequently the price of sugar rose high. The East India Company took advantage of this price rise in exporting sugar from India to England not as manufacturers but merely as merchants. In 1791, the company exported four parcels from Bengal to serve as loaf sugar for tea. The sugar was sold at Rs. 88-6-0 to Rs. 156-6-0 per cent. The economic policy adopted by the British Empire began to give impetus to the sugar industry in India. There were two groups of producers. They were the West Indian merchants and planters and the East India Company. The former were more influential because of the fact that the duties favouring the West Indian producers had been in force for many years. In 1821, the duty was modified and in 1836. East and West Indian Sugar entered England on equal terms for trading. The equalisation of duties led to sizeable increase in investment in sugar industry in India. Naturally, the West Indians and Mauritian planters were greatly attracted to India. Consequently by 1846, the export of sugar from India to Britain rose to 60,000 tonnes. Factories were started at Motihari, Azizpur,

Barachakia, Gorakhpur and Rosa in the west Indian plain with an aim to produce sugar direct from sugarcane. Bunkut was turned in to a sugar factory in 1904-05 with the latest and best machinery. Kachunia also was for some time used as a sugar factory⁷. The details of sugarcane in India as given by Watt in 1893 were as follow:

- (1) Mauritius cane.
- (2) Otaheite cane.
- (3) Bourbone cane.
- (4) Batavian cane.
- (5) China cane.
- (6) Singapore cane.
- (7) Indian cane.

Towards the close of the 19th century a great revolution took place in the method of sugarcane improvement. The discovery of fertile seed in sugarcane was made by Soltwedel in Java in 1888. A quite independent discovery of the improved and fertile seed was made by Bovell and Harrison in 1889 in Barbados. However, could not take advantage of the fertile cane seed till 1892. It was in the year 1892, that a special experiment and research station was organised Manjri, a place about 8 miles from Poona. The more important items of investigation work then taken up were the trial of different varieties of sugarcane already grown in the Bombay state and few

7. Minden Wilson, op. cit., pp 98-102

agronomic research on manuring and cultivation process. A great step forward in the sugar industry in India was taken after the setting up of a Sugarcane Breeding Institute at Coimbatore in 1912 on scientific lines. The credit for the present day development of the high-yielding varieties of sugarcane naturally goes to the Coimbatore Research Station. Sugarcane research work in the state is now done at the central Sugarcane research station, Pedegaon (Nira, Poona Distt) being shifted in 1932 various agronomical aspects of cane cultivation, soil classification and Sugarcane physiology have been carried on since then by the experts in this field⁸. The second earliest farm was established at Samalkota in the year 1902 by the department of Agriculture of Madras State.

Hadis work on sugar industry of U.P. was published out in 1902. The work has a comprehensive description of the various varieties of Sugarcane. The author has made a serious attempt in the work for the first time for the scientific study of Sugarcane specially from the view point of classification. In his memoir (1915) Woodhouse described as many as twenty-four indigenous Indian Sugarcane. The account presented in each case is vividly detailed and strictly botanical.

8. Sugarcane cultivation in Bombay State issued by Directorate of publicity, Government of Bombay, Bombay, 1957 (Sugarcane Research and Development Section of the Bombay State, Department of Agriculture.)

Towards the end of the 19th century, the indigo planters in Bihar with their colleagues in Bengal tried the Javanese method of indigo manufacture when indigo cultivation began to decline. A big plant, Begg Dunlop & Co., sent their men to Java to learn the process and some of the more enterprising planters at Hursingpur, Dalsingsarai and Belsuned turned to sugarcane cultivation. Pottar and Co., the firm of Alexander's processing plants. Arthur Butler & Co., of Muzaffarpur took up the replacement of machine parts⁹. Some of the concerns sold their land which was acquired by the big landlords of Darbhanga, Huthwah, Bettiah and they employed the planters to run the sugarcane plants or the 'sick' indigo concerns. Many of the planters took to managing Zamindaries. The Viceroy, Lord Curzon took great interest in sugarcane cultivation. Mr Coventry a Bihar planter had done research in sugar cane cultivation and manufacture. When the American millionaire, Mr. Phipps visited India and made a lavish grant to Lord Curzon he sponsored the Pusa Agriculture college in Darbhanga District and Mr. Conventy was recruited, on the Board of Directors. The great Bihar earthquake in 1934 demolished the Naulakha buildings and Pusa College was transferred to New Pusa College in Delhi.

9. Roy Chaudhary, P.C., "Last Days of the Indigo Planters," The Times of India, February 6, 1977

The Institute did excellent work for sugarcane research in Bihar ¹⁰.

India used to export large quantities of sugar, primarily unrefined upto the middle of the nineteenth century. Till 1863-64 the exports from India exceeded the imports. The position was, however, quite reverse from the year. The first onslaught on the sugar industry of India was made by Mauritius and later from the bounty-fed beet sugar of Europe. The import of sugar from Java captured the Indian market. In this way the hard competition from foreign countries made the situation of sugar industry in India quite hopeless. From 1884-85, the imports of sugar began to increase rapidly.

The Government in majority of the sugar exporting nations fruitful efforts propagate and render help and succor for the better methods of manufacturing best or sugarcane besides improving the varieties. The Government in Java and compulsion or inducement to the cane growers in concentrated blocks so that central factories may be erected economically viable¹¹. With the advent of the East India Company, the Indian Sugar Industry received a set back and European planters in the West-Indies developed sugar industry. There was, however, some temporary revival in 1836 when the rates

10. The Indian Famine Year Book, 1936, p.270.

11. Bagchi, A.K. Private Investigation in India, 1900-39 (Cambridge University Press, 1973), pp 360-365.

of duty on west Indies sugar were raised. But because of the adoption by England of the principle of free trade in 1846, in Indian industry receded to the background.

It is worthy of mention that the increase in the quantity of sugar imported from foreign countries was obviously visible in spite of a heavy import duty levied by the government. The range of import duty was from 50% to over 100% and as such the Government of India received a vast amount of money there from. In the year 1900-01, for example, the earning of Government of India from import duty on sugar was of the order of Rs. 53 lakhs. Though there have been extraordinary high expenditure and remarkably high revenue yield from sugar import for many years, the Government did not realise the full significance of the development of the sugar industry until after the first world war in spite of its National importance from the view point of agricultural, rural and industrial economy¹². Import of sugar figured prominently till it suffered a set back during the years of world war I when on an average the annual imports were 5,31,713 tonnes as against the previous annual average of 7,23,915. The peak figure was reached in 1929-30 when the imports reached the all high figure of 9,30,600 tonnes. The possibility of utilising the sugar resources of India was examined

12. Ibid.

after the first world war without any fruitful result by the Government. In february 1919, W. Sayer was appointed by the Government of India to compile relevant data as regards the best method of exploiting the advantages this country possessed in respect of sugarcane. In 1920, the Indian Sugar Committee was appointed to examine the position of Indian sugar from the stand point of world's sugar supply and to make recommendations for the betterment of its position. When the position of sugar industry was examined by Indian Sugar Committee (1920), there were 22 sugar factories in India working only with sugarcane. Of these, 10 were situated in North Bihar, 5 in united provinces (U.P.), and 3 in Madras. Of the 5 factories in U.P., 3 were located on the boarders of Bihar in the District of Gorakhpur. The production from the 18 factories actually working during 1919-20 was only 23,100 tonnes of sugar and the production was approximately equal to the production of three average factories of Java.

India has been an exporter of sugar upto middle of the 19th century. But soon after the began to import refined sugar, mostly from the British colony of Mauritius from 1890 imports of bounty-fed sugar from Austria and Germany began to increase¹³. This was bound to affect the import of sugar from Mauritius

13. Chandra, Bipin, The Rise and Growth of Economic Nationalism in India (People's Publishing House, New Delhi, 1966), p. 307.

and manufacturer of sugar as well as cultivation of sugarcane in India. It was estimated that on account of dumping of cheap European sugar, cultivation of sugarcane in India had decreased by 13%. The period also witnessed widespread closing down of sugar refineries¹⁴. Complaints against the entry of European sugar into Indian market were made to the Government of India, not by the Indian manufacturers and cultivators of sugarcane but by the importers. Accordingly, in March 1899, a Bill to levy a countervailing duty on import of bounty-fed sugar was introduced to the legislative council. But the government vehemently denied that in taking the decision, it was influenced by imperial considerations, such as the protection of the interest, of the planters and manufacturer of Mauritius. The Bill was unanimously passed¹⁵.

The imposition of the countervailing duty, however, did not produce the desired result. Imports of beet sugar continued to increase. In 1902, therefore, rates of countervailing duties were further legislation of the Government of India was to save the sugar industry of Mauritius and Java, rather than to protect the Indian Sugar Industry. The idea of protecting the latter was more incidental than

14. Shah, N.J., History of Indian Tariffs (Thacker & Co. Ltd., Bombay, 1924)

15. Chandra, Bipin, op, cit, p. 252.

intended. As a matter of fact, the largest quantity of the sugar manufactured in India was unrefined, and this could not compete with the refined European sugar. Hence, there was no danger to India's Sugar Industry by the import of European sugar¹⁶.

As for the development of the refined Sugar Industry in India was concerned, bounty-fed sugar from Europe was as much inimical to its growth as the sugar from Mauritius. Both of them played on equally important role in running Indian sugar refineries. Shri Prithwis Chandra Ray, an eminent economist of Bengal had observed in his pamphlet on the sugar industry that even before the entry of bounty-fed sugar, i.e. between 1883-90, in Bengal alone, 89 sugar factories had to be closed down as a result of competition with duty-free sugar of Mauritius.

Another issue of importance relating to the tariff policy of the previous period was that of the 'Imperial Preference'¹⁷. The first occasion to state India's stand on imperial preference arose in 1903, when Lord Curzon was the Viceroy. His Government was opposed to the idea of granting Imperial Preference to the British goods. India's export consisting mainly of important industrial raw materials were admitted in foreign countries either free of any duty or on payment of moderately uniform duties.

16. Shah, N.J., op. cit, p. 309.

17. Chandra, Bipin, op. cit, p 256.

When the first world war broke out in 1914, India was in a fairly sound financial position. However due to continuation of in the war for a protracted period, imposition of additional taxation became inevitable. In 1916. the "list of exemption" was considerably reduced and the general import duty was raised from 5% to 7.5%. Increase in duty was chiefly on sugar which went upto 10%. The continuation of the war presented India manufacturers with an opportunity of a kind unknown before. On the one hand, there was a big demand for manufactured goods to meet the war requirement of the Government, and on the other, there was an unprecedeted shrinkage of imports of manufactured goods from Europe, providing automatic protection against foreign competition which normally could have been gained only through high tariffs. There was one significant gain which emerged from the war, for industrial development of the country. The changed outlook of industrial policy of the Government led to the appointment of the Industrial Commission in 1916, to examine and suggest the ways in which government could give encouragement to industrial enterprises. Thus the first world war had set the stage for the evolution of the Indian Tariff Policy in proper perspective in the best interest of sugar industry too.

With the end of the war, the respite from foreign competition was over. This caused an immediate set-

back to the industrial development. The general import duty was raised from 11% to 15% in 1922 but the import duty on sugar was raised from 10% to 15% in 1921 and to 25% in 1922. The question of adopting a policy of protection was taken up the Indian Legislature in february 1923 on a non-official resolution of Mr. Jamnadas Dwarkadas, a member of Fiscal Commission. The resolution was finally accepted by the Government of India under pressure form educated public opinion. The war period may be set to be the turning point in the history of the tariff policy of the country. Its combination came in the post war period.

The policy of discriminating protection was neither broad-based in scope nor was applied with sympathy. As a result, protection was granted only to a few industries. But despite, its limitations and defects, there is no denying the fact that the policy of discriminating protection, benefitted considerably the protected industries, amongst which the sugar industry has a significant position. The substantial increase has been registered by sugar industry under protection. In fact, beneficial result of protection was discernible in sugar industry even before the outbreak of the second world war. IN the case of the sugar, import was felt within, three to four years, after the grant of protection.

The committee wanted the government to set up a sugar Board, a sugar Research Institute and a sugar school to train up sugar technologists. One of the recommendations was for fixing the scale of prices for sugarcane growers by the government for the protection of the cane growers against exploitation by the sugar factories. But the non-implementation of the recommendation of the Indian sugar committee (1920) by the government for many years naturally could not give any impetus to the development of sugar industry. The revenue duty on sugar went on increasing. It was raised from 5% ad valorem to 10% in 1916. Again it was raised to 15% in 1921 and 25% in 1922. In June 1925, the import duty on sugar based on ad Valorem was converted into a specific one and the rate rose to Rs. 4-8-0 per Cwt. This rate continued upto february 1930. These changes in policy of revenue duties brought about by the Government of India aimed at realising higher revenue without any guarantee on the part the government for the protection of sugar industry in future ¹⁸.

Sugar industry has become one of the major agro-based industries in India since the colonial days. As a matter of fact, during the colonial rule this industry was promoted with a view to commercialising agriculture so that the peripheral area would be

18. Report of Indian Sugar Committee, 1920, Chapter XIX.

linked with urban market through money commodity relations. Hence the limited purpose to promote sugar industry could not take a comprehensive view for its development and the administration of the British merchant capital retained its forced commercial character leading to a dual structure of sugar production - capitalist and pre-capitalist. Moreover the forces of trade and commerce could not make this industry more than a commercial enterprise being a subject to the role of the market forces. In course of time, sugar became one of the major items for mass consumption. But the commercial character of this industry being a subject of market forces made its production fluctuating in character. However in free India some efforts were made to promote sugar industry as an integral part of industrial development in particular¹⁹.

2.3 Sugar Industry in Free India:

During the period 1942-43 till 1950-51 the sugar industry of India had to pass through a difficult time for various reasons when the output fluctuated erratically between about 9 to 11 lakh tonnes mainly on account of the instability of sugarcane supplies caused by the Government's preference to food crops during the war years.

19. Tyagi, R.C., "Problems and Prospects of Sugar Industry in Uttar Pradesh", Working paper No. 75, G.I.D.S. Lucknow.

In view of the critical situation and crisis phase of sugar industry, sugar was decontrolled in December 1947 and as a result of it the price of sugar rose rapidly. This situation led to black marketing and hoarding and consequently the consumers were badly affected. The circumstances compelled the Government to recontrol sugar in 1949. Really, the sugar industry received its due share of consideration in the five year plans of the Government of India. The first five year plan laid down a production target of 15 lakhs to be reached by 1955-56 against the actual production of 11.16 lakh tonnes of 1950-51 (i.e. The base year of the plan). Fuller utilisation of the existing capacity of the sugar factories was emphasised but the first plan had not provided for any further expansion of the size or magnitude of the sugar industry. But a new era commenced for the industry in 1951 because of the fact that development and regulation of sugar industry came under the control of the Government of India for the first time in its annals. Under the industries (Development and regulation) Act of 1951, regulation of the sugar industry came under the control of the Central Government. In 1950-51 prior to the initiation of the First Five Year Plan, there were 139 sugar factories in India of which 3 were co-operative and 136 joint stock and other factories. The total sugar production capacity was of the order of 16.68 lakh of tonnes

every year of which 16.50 lakh of tonnes every year was contributed by the joint stock and other factories. Of the three (3) co-operative sugar factories One (1) was in Maharashtra and two (2) in Andhra Pradesh. The subtropical belt had 109 sugar factories accounting for 78 per cent of both the total number of factories and the over all sugar production capacity in the country. Under the industries (Development and Regulation) Act of 1951, all the 139 sugar factories were registered. New sugar factories to be set up in future were subjected to the provisions of the act for licence.

The first enquiry in the cost structure and fair price payable to the sugar industry was held in 1958-59 by the Tariff Commission which submitted its report to the Government in September 1959. The Government of India in 1958 also appointed a fact finding committee on Khandsari Sugar to ascertain its position vis-a-vis the sugar, the extent of diversion of cane to Khandsari in factory Zones and to suggest measures necessary to meet the situation. In June 1963, the Government of India appointed a committee on Rehabilitation and Modernisation of sugar factories in India (under the chairmanship of S.N. Gundu Rao) to examine to the problems of the old and uneconomic units of sugar industry was appointed under the chairmanship of Dr. S.R.Sen to make a comprehensive enquiry in to the various aspects of the sugar

industry including the economics of sugar production and its cost structure. The cost schedules recommended by the commission in its Report of October 1965 were adopted by the Government for fixing ex-factory price of sugar during the years from 1965-66 to 1968-69. On the industries representation and plea about the absolute cost data based on the 1963-64 cost structure, the Government in February 1968 referred this question to the Tariff Commission. The Government accepted the major recommendation of the commission after announcing their decision on 20th February, 1970. As recommended by the commission the number of price zones was increased to 15. The cost schedules and the Zones recommended by the commission in its report of 1969 were based on the data of the year 1966-67, so again on 2nd December 1972, the Tariff Commission was requested by the Government to recommended cost schedules, Zones, etc, for a period of three years (i.e. 1972-73 to 1974-75).

At the time of enquiry by the commission in 1969, there were 205 units manufacturing sugar. The number of units manufacturing sugar increased to 229 in 1971-72. On the 28th September, 1970, the sugar industry enquiry commission was set by the Ministry of Agriculture (Then known as Ministry of Food, Agriculture, Community Development and Cooperation) with the main terms of reference like working of the sugar industry and the condition of the plant and

machinery of the sugar mills, causes, for the existence of a large number of sick sugar mills, working of co-operative sector sugar mills, suggestions for a rational and efficient organisation of the sugar industry in different part of the country, problems of cane supply and payment of cane price along with fluctuation of sugar and sugarcane production and suggestions there about for a stable and balanced development of the sugar industry.

From March 1970, the sugar industry along with other industries was permitted to expand without a licence provided that the value of the fixed assets of a unit after expansion did not exceed Rs. 5 crore and provided further that the aggregate value of the substantial expansion whether in one stage or more than one stage did not exceed Rs. 1 crore. It seems that the third phase in the history of the Indian sugar industry since 1951 is one of the planned and regulated growth, mostly in the tropical south. Prior to 1951, the sugar industry was mainly concentrated in the sub-tropical belt which accounted for 108 out of a total of 139. Most of the factories were situated in Uttar Pradesh and Bihar, their number being 68 and 29 respectively. After 1951 the industry rapidly spread itself in the tropical belt comprising Gujarat, Maharashtra, Andhra Pradesh, Tamilnadu, Pandichery, Kerala and Mysore (Karnataka). The number of factories in this belt rose from 31 in 1950-51 to 88

in 1967-68 it rose to 105 by 1971-72. In this way, as many as 74 new factories were started in this belt in about 20 years. As against this the number of sugar mills in the sub tropical region increased from 108 in 1950-51 to only 117 in 1967-68 and 124 in 1971-72²⁰.

The number of factories under co-operative sector was more than one third of the total number of the sugar factories in this country in 1974-75. The most significant development in the Indian sugar industry during the last 25 years is the emergence and rapid growth of the co-operative sector primarily due to the preferential treatment given to this sector by the government in according licence and giving financial assistance. Of the 96 factories under co-operative sector in Maharashtra. The tropical belt has brought about outstanding major changes. Of all the states in the tropical region, Maharashtra alone comprises of more than 50% of the total co-operative sugar factories. In 1974-75, The number of sugar factories in Maharashtra under co-operative sector was 42.

In the first Five Year Plane period the volume of sugar production was 18.92 lakh tonnes, resulting in an increase of 69.23 percent over 11.18 lakh tonnes in 1950-51, on there of planning period. The role of the industry in the Second Plan was also equally commendable. The second Five Year Plan had boosted

20. Tariff Commission Report, Bombay, 1973, Chapter II, p. 6.

the sugar production to 30.28 lakh tonnes with 170.84 percent increase over the production in 1950-51. With 35.47 lakh tonnes in the Third Five Year Plan, the percentage of increase in production was 215.92 thus exceeding the target of 35 lakh tonnes fixed under the plan. IN the Fourth Five Year Plan sugar production had touched 39.48 lakh tonnes with 253.13 percent increase over the production in 1950-51. With larger carry forward stock of about 22 lakh tonnes from the previous season, the total availability of sugar production improved to 38.7 lakh tonnes in 1972-73 and about 39.48 lakh tonnes in 1973-74 due to the increase in sugarcane acreage and its production. The industry had achieved a sugar output 47.9 lakh tonnes in 1974-75 against 39.48 lakh tonnes achieved during the preceding season 1973-74. the sugar production during the season declined from 47.92 lakh tonnes in 1974-75 to 42.61 lakh tonnes due to serve drought conditions in Tamil Nadu as also due to declined in production in Uttar Pradesh and Andhra Pradesh. With about 58.42 lakh tonnes of sugar during the Fifth Five Year Plan, the country had more than 422.5 per cent increase ²¹.

Due to abundance of cane supply and its lower off take by Gur and Khandsari producers, the sugar factories had to crush more cane during 1977-78 season utilising 37 per cent of the cane crops as against

21. The Indian Sugar Mill Association, New Delhi, 110 019, Indian Sugar, Vol. 31, No. 6 September 1981, p. VI

their normal intake of about 30 per cent. The industry achieved a record production of 64.72 lakh tonnes by continuing crushing the hot summer months with an installed capacity of about 55 lakh tonnes. The Government of India had estimated the requirement of sugar at 76.40 lakh tonnes by the end of Sixth Five Year Plan (e.e by the year 1984-85). For achievement of this goal, the targets of the installed capacity and licensed capacity had been put at 80.4 and 96.2 lakh tonnes, respectively. India had the unique distinction of being the world's largest producer of sugar in 1981-82 with 8.4 million tonnes exceeding the production Cuba and Brazil. A notable feature of the season 1981-82 was the achievement of an all time record sugar output which was initially visualised at 75 lakh tonnes actually turned out to be much higher at 82.3 lakh tonnes. In this way India maintained its class in the top ladder of the world sugar producers although it relegated to the second position next to Brazil in the season 1982-83²². The Sixth Five Year Plan had increased sugar production with 449.55 per cent increase over the production 1950-51²³.

However, the sugar output had declined to only 59.17 lakh tonnes from 82.30 lakh tonnes in the

22. Indian Sugar Year Book 1983-84, Vol.1, pp, 6-67, Indian Sugar Mills Association, Sugar House, 39, Nehru Place, New Delhi.

23. The National Federation of Co-operative Sugar Factories Ltd., New Delhi 110 019, Co-operative Sugar, April 1986 statistics Section.

previous season with a decrease of 28 per cent. While the overall sugarcane production declined by 6.6 percent, the sugar output declined by as much as 28.1 per cent. The sugar year 1982-83 commenced with a carry forward stocks of 32.7 lakh tonnes. With the production of 82.30 lakh tonnes, the availability of sugar was the highest being about 115 lakh tonnes and the off take both for internal market and export was also higher at 64.88 and 4.25 lakh tonnes respectively²⁴.

During the 1983-84 season, sugar production declined to 59.16 lakh tonnes. In 1984-85 the position of sugar production was 61.44 lakh tonnes which was slightly higher than the previous season's production. The pragmatic sugar policy followed by the Government in the first 3 years of the 7th Five Year Plan has helped increasing sugar production substantially through better availability of cane to sugar mills and higher productivity. Among other measures, the liberation of levy free ratio from 65:35 to 50:50 has been the main contributory factor for maximisation of sugar output. The Sugar production increased by 14.2% in 1985-86, 38.4% in 1986-87 and 48.3% in 1987-88 over the production in the base year

24. Indian Sugar Year Book 1983-83, Vol. 1. Indian Sugar Mills Association, New Delhi p. 118.

1984-85²⁵. This was possible through higher drawls of sugarcane and improvement in productivity.

2.4 Present Position of Sugar Industry:

There are at present 417 licensed sugar factories in the country, consisting of 127 in the private sector, 58 in the public sector and 232 in the co-operative sector. The total number of installed sugar factories in the country are 386 out of which 119 in the private sector 56 are in the public sector and 211 are in the co-operative sector. In our country all the three sector, namely private, public and co-operative are associated in sugar industry. Similarly, all these three sectors are also prevailing in Uttar Pradesh. There are 107 licensed sugar factories out of which 104 are installed factories in this state, consisting of 47 private licensed factories, out of which 45 are installed, 29 are in public sector, all these are installed and 31 are in co-operative sector, out of which 30 are installed factories. (Table 2.1)

Most of the existing plants and machineries are more than five decades old. This is specially the case in Northern India. They all need immediate modernisation and revitalisation. Because of old machinery the factories have often to be closed for

25. Indian Sugar Year Book 1987-88, Vol. 1. Indian Sugar Mills Association, New Delhi p. 133.

Table 2.1

**State-wise Total Number of Licensed and Installed Sugar Factories,
in India (Position as on 30.9.89)**

S.No.	State	Total number of existing licensed sugar factories				Total number of installed sugar factories				Total
		Private Sector	Public Sector/ State Owned	Coop Sector	Total	Private Sector	Public Sector/ State Owned	Coop Sector	Total	
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	
1.	Uttar Pradesh	47	29	31	107	45	29	30	104	
2.	Bihar	20	10	-	30	20	10	-	30	
3.	Punjab	2	2	13	17	2	2	9	13	
4.	Haryana	1	-	10	11	1	-	7	8	
5.	West Bengal	1	1	-	2	1	1	-	2	
6.	Assam	-	1	2	3	-	1	2	3	
7.	Nagaland	-	1	-	1	-	1	-	1	
8.	Rajasthan	1	1	1	3	1	1	1	3	
9.	Madhya Pradesh	5	-	3	8	5	-	3	8	
10.	Orissa	1	1	4	6	1	-	2	3	
11.	Maharashtra	11	-	93	104	11	-	89	100	
12.	Gujarat	-	-	17	17	-	-	17	17	
13.	Goa	-	-	1	1	-	-	1	1	
14.	Tamil Nadu	17	2	16	35	12	2	12	26	
15.	Karnataka	8	3	19	30	8	3	17	28	
16.	Pondicherry	1	-	1	2	1	-	1	2	
17.	Andhra Pradesh	11	6	18	35	10	6	18	34	
18.	Kerala	1	-	2	3	1	-	2	3	
19.	Manipur	-	1	-	1	-	-	-	-	
20.	Dadar Nagar Haveli	-	-	1	1	-	-	-	-	
All India Total		127	58	232	417	119	56	211	386	

Source: Indian Sugar Year Book (1987-88), Vol. I, Indian Sugar Mills Association, New Delhi, p. 69.

mechanical break-downs etc. Bhargava Commission in 1974 concluded: "In 1973, performance of 40 per cent or 78 out of 197 factories that he studied was below normal, mainly because of mechanical break-downs. The net result of these factors is that the recovery of sugar is only 10 per cent from sugar content or 12 per cent. Sickness in sugar industry is primarily related to old unit which are technically inefficient due to either obsolescence of plants and equipments²⁶. Because of this sorry state, the sugar growers are not paid up to date for their sugarcane and huge amount of arrears are due to be paid to them. This discourages cane-growers both to cultivate sugarcane and to supply it to sugar factories. Thus, in fact the sugarcane, which is a cash crop has turned into a credit crop for sugarcane growers. Our country which was a net exporter of sugar has, because of the fall in sugar production due to the shrinkage of acreage under sugar-cane, become a net importer of sugar. In 1984-85, India imported Rs. 200 crore worth of sugar.

2.5 Sugar Production Technology Employed:

As a demand for white sugar went up particularly after the first world war, the import bill started proving a big drain on the India economy. The Government was, therefore, forced to encourage the Vacuum Pan Sulphitation (VPS) industry by passing a

26. Vidyasagar, The Economic Times, dt. 8-7-1985.

sugar industry Protection Act. in 1932, under which an import duty on sugar was imposed. As a result of the giant of protection to the sugar industry a phenomenal rise took place in the number of industries as well as in the area under sugarcane cultivation. Beside this the Government also instituted a research scheme for improving the efficiency of the Khandsari industry and this industry also started producing white crystal sugar by improving, their techniques of production. Between 1936 and 1948 the Gur and Khandsari scheme of Bilari was instrumental in developing a new process known as the "Open Pan Sulphitatin Process" (OPS). This process not only improved the sugar recovery but also the quality of Khandsari sugar. The technology employed is a simple version of the chemical processes in a sugar mill, but with some characteristics of the Khandasari sugar cottage industry. In favourable circumstances the sugar produced in the small units is of the same technical standard - in the terms of colour, size and dryness of the crystals, as average mill sugar, although it is more generally not quite up to that standard. C.G. Baron²⁷ elaborated that the distinction between millsugar and OPS sugar was one to be drawn only by a specialist. A technologist at the Nation Federation of co-operative sugar factories agreed that some of the OPS sugar was "very good". On

27. C.G. Baron "Sugar Processing Techniques in India"- Edt. A.S. Bhalla "Technology and Employment in India. p. 178

the other hand, the extent to which OPS sugar deviates from the best standards of white, hard dry crystals is certainly dependent up on the diligence and skill of the supervisors in the small-scale units, which vary. In the mills, on the other hand, the chemical processes-boiling times and temperatures, etc.- are well known and documented.

In India mostly sugarcane is used as raw material for the production of sugar. However, sugar is produced both from sugarcane and sugar beets. Generally in European countries sugar beets serve as raw material for the production of sugar. In the India only a few sugar mills, - mainly Ganga Nagar sugar Mill, Sri Ganga Nagar, Rajasthan utilise sugar beet as a raw material. In 1982-83, 2186 tonnes of beet sugar was produced the recovery in that year was 9.56 per cent. It is estimated that about 36 per cent of the sugar produce in the world comes from sugarcane while the share of sugar beet in the production of sugar is 64 per cent²⁸.

So it is clear that now a days mainly two technology are employed in sugar manufacturing sector. One is Vacuum Pain sulphitation and other is Open Pan Sulphitation.

28. Roy, R.N. "Sugar Industry in Darbhanga Division" Book, Capital Publishing House, Delhi, (1988) p.41.

2.6 VPS Technology:

The first and the most important category of units are the large sugar mills (VPS) which manufacture white crystalline sugar. As already being mentioned that these units are found in the private, public and co-operative sectors. The public sector units are mainly those which had been taken over by the government on becoming sick units. Beside these, there are also some units which were established as public sector units since their beginning.

In order to ensure adequate supply of sugarcane to the large mills the government has reserved an area of 16 kilometers around the sugar mill from which they are to purchase their sugarcane. No other sugar mill can encroach in to the reserve area of any particular unit. Within each reserve area there is a co-operative society and all the growers who wish to sell their sugarcane to the mill have to be registered numbers of this society. The sugar mill then gives its day to day requirement details to the society which in turn selects the cultivators who are to supply the cane to the sugar mill. In this manner it tries to ensure that all the cultivators get their turn in rotation and without any inconvenience either to the cultivators or the sugar mills. The government also fixes a minimum cane procurement price every year to safeguard the interest of the cultivators. The payment for cane supplied is made to the cultivators through the co-operative society and for this service the co-operative society charges them around two per

cent by way of service charges. While the central government announces a procurement prices, of sugarcane, the state government also announces its price for the state and these are always slightly higher than those announced by the central government. The sugarcane procurement prices have been going up sharply. In 1976-77 the procurement prices announced by the Central Government were Rs. 10.80 per quintal (maximum price) as against the maximum price offered by the state government was Rs. 13.25 per quintal. By 1989-90 these had gone up to Rs. 29 per quintal in case of Central Government whereas the corresponding prices announced by the state government was Rs. 38 per quintal (Table 2.2). Further the comparative figures of total cane crushed, recovery, sugar production, duration and crushing capacity from 1971-72 to 88-89 in India and Uttar Pradesh by sugar factories has been compiled from the various volumes of ISMA and given in the Table 2.3.

According to the Annual Survey of Industries (ASI) the state as a whole had 81 registered by only 78 units filled in their ASI returns. Thus here providing data pertaining to only those units from which returns were received. The data are being given for four point of time. Between 1976-77 and 1985-86 (the latest year for which the ASI report is available) the number of unit in the state filing their returns rose from 78 to 91. Correspondingly their fixed capital registered an almost four fold increase from around 5,000 lakh rupees to around

Table 2.2

**Cane Crushed, Sugar Production and Sugarcane
Prices Fixed in U.P.**

S.No.	Year	No. of Units	Cane Crushed	Sugar Pro-	Price fixed by Govt. of India		Price fixed by U.P. Govt.	
			(lakh qtl.)	(lakh qtl.)	Mini.	Maxi.	Mini.	Maxi.
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	
1.	1976-77	79	1515.30	147.10	8.50	10.80	12.25	13.25
2.	1977-78	85	2054.40	186.20	8.00	11.00	12.50	13.50
3.	1978-79	88	1576.40	146.30	10.00	12.71	10.00	12.71
4.	1979-80	89	1020.30	99.70	12.50	16.03	12.87	22.00
5.	1980-81	90	1293.50	122.40	13.00	17.28	19.00	26.00
6.	1981-82	91	2278.50	208.00	13.00	16.52	20.50	21.50
7.	1982-83	92	2104.00	293.50	13.00	16.67	20.50	21.50
8.	1983-84	94	1851.40	172.70	13.00	18.90	20.50	21.50
9.	1984-85	99	1544.80	147.70	14.00	17.46	21.00	22.00
10.	1985-86	101	1721.70	164.80	16.00	20.58	23.00	24.00
11.	1986-87	102	2711.00	255.60	17.00	22.00	24.00	25.00
12.	1987-88	104	2996.50	266.60	18.00	24.10	26.00	27.00
13.	1988-89	104	2429.30	230.20	19.50	23.63	28.50	30.00
14.	1989-90	104	3328.00	300.00	22.00	28.49	38.00	38.00

Source: Cane Commissioner's Office, Lucknow.

Table 2.3

**Total Cane Crushed, Recovery, Sugar Production
Duration and Crushing Capacity of Sugar Factories from
1971-72 to 1988-89 in India and Uttar Pradesh**

Year	INDIA					UTTAR PRADESH				
	Total Cane Crushed (000 Tonnes)	Sugar Recovery (%)	Total Sugar Produced (000 Tonnes)	Average duration (days)	Actual Cane Crushing Capacity (per 24 hors)	Total Cane Crushed (000 tonnes)	Sugar Recovery (%)	Total Sugar Produced (000 Tonnes)	Average duration (days)	Actual Cane Crushing Capacity tonnes (per 24 hors)
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	
1971-72	30997	10.03	3108	107	1338	15190	9.39	1210	90	1392
1972-73	40407	9.57	3873	133	1399	15705	9.51	1371	139	1443
1974-75	48435	9.90	4794	140	1428	15170	9.43	1431	146	1445
1975-76	41849	10.19	4262	115	1458	12196	9.55	1163	112	1500
1976-77	48819	9.22	4840	126	1481	15006	9.71	1471	130	1460
1977-78	67329	9.66	6457	167	1385	20546	9.07	1862	182	1320
1978-79	59717	9.78	5842	140	1499	15767	9.28	1463	136	1446
1979-80	39050	9.88	3858	86	1461	10205	9.77	997	83	1424
1980-81	51584	9.98	5147	105	1527	12921	9.46	1225	99	1462
1981-82	87342	9.66	8436	173	1628	22790	9.13	2080	176	1510
1982-83	82695	9.66	8232	158	1674	21041	9.67	2035	156	1540
1983-84	59022	10.03	5916	111	1647	18514	9.33	1727	127	1606
1984-85	60092	10.24	6144	107	1813	15448	9.58	1478	97	1773
1985-86	68576	10.23	7016	116	1708	17211	9.59	1650	108	1646
1986-87	85224	9.98	8501	141	1744	27110	9.43	2557	164	1710
1987-88	93943	9.70	9110	153	1609	29975	8.90	2665	173	1600
1988-89	85693	10.21	8752	133	1657	24289	9.49	2302	137	1662

Source: Indian Sugar Year Book p.II, 1984-85, 1987-88 and 1989-90.

19,300 lakh rupees. Similarly there was also an appreciable increase in the value of working capital. In terms of employment however, it is observed that total employment has gone down to less than half in absolute numbers. Since the total number of units has given up, it find a corresponding increase in both total value of inputs as well as total value of output. The value added per workers has experienced a very high increase from a mere Rs. 4,858 in 1976-77 to Rs. 35,426 in the year 1985-86.

In the case of Bijnor, it has been observe that, except during the year 1979-80 when there were 4 units for the remaining three point of time. However, the value of fixed capital went up nearly ten times between 1976-77 and 1985-96. On the other hand, there has not been much of a variation with respect to value of working capital except during 1982-83 when it suddenly dropped to a very low figure, total employment, as could be expected, was higher for the year when there were of units otherwise employment too has fluctuated only between 3 to 4.8 thousand. It is interesting to find that during 1985-86 employment levels at the all U.P. level as well as in the case of individual districts has gone down. This could be because of the modernisation of plant and machinery which is less labour intensive. While there was no change in the total units, total production went up quite considerable from around 1868 lakhs to nearly 6093 lakh rupees. Consequently, value added per worker has also witnessed a very sharp rise.

The district selected for the study, Bijnor having 5 units of sugar mill in 1989-90. There were 4 units in the year 1987-88 and 1988-89. Sugar production was 21.25 lakh quintal in 1987-88, 17.18 lakh quintal in 1988-89 and 25.82 lakh quintal in 1989-90. Cane crushed was 235.03 lakh quintal, 176.43 quintal and 286.92 quintal in the corresponding year (Table 2.3).

On the whole it has been observe that while the total number of sugar factories have not risen very much appreciably either with in the state as a whole or even in selected district-Bijnor. There has been a considerable increase in the values of fixed capital, total output and value added per worker (Table 2.4).

Table 2.4

Cane Crushed and Production of Sugar by Sugar Factories in District Bijnor

Name of District	Year	No. of Units	Cane Crushed (lakh qtl.)	Sugar Production (lakh qtl.)
(1)	(2)	(3)	(4)	(5)
Bijnor	1987-88	4	235.03	21.25
	1988-89	4	176.43	17.18
	1989-90	5	286.92	25.82

Source: Annual Survey of Industries, Economic and Statistics Division.

2.7 OPS Technology:

The second and also the most important category of sugar manufacturing units, as far as labour absorption is concerned and low capital requirement, as compared to big mill, are improved Khandsari sugar units, which manufacture white crystal sugar and other products and by products. As far as different products are concerned, the unit manufacture, apart from crystal sugar, Khandsari, pure gur, Raab for sale as Raab itself, molasses and Badda gur. Badda gur is nothing else but solidified molasses in the shape of pure gur. It is dark brown, while Khandsari and pure gur are used directly for consumption, Raab, molasses and badda gur may be used either directly for consumption or as an intermediate product in the manufacture tobacco and alcohol. In fact bulk of the molasses and badda gur produced goes into the production of alcohol.

Looking in to the data provided by the Annual Survey of Industries, the state as a whole had a total of 740 registered factories which provided their details for the ASI, their number went up 1979-80 (790 units) as well as in 1982-83 (115 units) but came down in 1985-86 (968 units). Similarly in selected district Binjor, number of units went up 22 units in 1979-80 as well as 245 units in 1982-83 but came down to 208 units in 1985-86. This conforms to the overall assessment that their number have been declining over

the years. The initial increases are because some of the units which earlier were not registered under the factory Act came under the preview of the act at time went by.

During 1976-77 the value of fixed capital was around Rs. 1243 lakhs but by 1985-86 it had more than doubled to Rs. 2734 lakhs. Similarly there was an even greater increase with respect to working capital. Unlike the sugar industry where we observed a declining tendency in total employment between 1976-77 and 1985-86 has registered an increase which probably indicates the fact that there has been no modernisation of these units and that they continue to be traditional and labour intensive (Table 2.5).

The total output of OPS sector has risen sharply between 1976-77 and 1985-86. The increase registered has been around 195 per cent. However, since the sector is traditional and relatively not perfect using labour intensive technology the value added per worker has hardly shown any increase. It increased from Rs. 2074 in 1976-77 to 3551 in 1985-86, an increase of only 71.22 per cent whereas to the corresponding increase in the case of the sugar industry was well over 625 per cent.

The district Bijnor, which is selected for the present research work, had the highest number of registered Khapsari units-221 units in 1976-77. By 1985-86 this number had goes down to 208. However,

Table 2.5

**Value of Fixed and Working Capital, Total Employment,
Value of Total Inputs and Output, Value Added and Value
Added per worker in Sugar Industry of U.P. and Distt. Bijnor**

Year	Return Received Units (Nos.)	Value of Fixed Capital (Lakh Rs.)	Value of Working Capital (Lakh Rs.)	Total Employment (Nos.)	Value of Total Inputs (Lakh Rs.)	Total Outputs (Lakh Rs.)	Value Added (Lakh Rs.)	Value Added per Worker (Rs.)
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Uttar Pradesh								
1976-77	78	5025.24	3221.22	126652	21425.19	27053.16	4988.01	4858
1979-80	85	11318.64	4091.62	122839	27198.12	32953.80	4096.03	4191
1982-83	91	14297.39	9135.73	118825	61490.30	74470.47	10728.50	11480
1985-86	91	19270.05	8654.64	61368	47404.12	67410.56	16338.92	35426
Bijnor								
1976-77	3	157.74	242.61	3695	1498.57	1868.33	337.39	12436
1979-80	7	1294.00	228.52	6962	2290.46	2683.90	193.47	3602
1982-83	4	1062.96	46.68	4719	4173.05	5009.97	671.34	18418
1985-86	4	1552.96	207.32	3030	4055.03	6082.92	1686.25	76717

Source: Annual Survey of Industries, Economics and Statistics Division, State Planning Institute, U.P. (Year-wise Reports).

Table 2.6

**Value of Fixed and Working Capital, Total Employment,
Value of Total Inputs and Output, Value Added and Value
Added per worker in Khandsari (OPS) Industry of U.P. and Distt. Bijnor**

Year	Return Received Units (Nos.)	Value of Fixed Capital (Lakh Rs.)	Value of Working Capital (Lakh Rs.)	Total Employment (Nos.)	Value of Total Inputs (Lakh Rs.)	Total Outputs (Lakh Rs.)	Value Added (Lakh Rs.)	Value Added per Worker (Rs.)
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Uttar Pradesh								
1976-77	740	1243.04	443.85	58048	5858.99	7071.16	1085.63	2074
1979-80	790	1497.40	776.62	68479	4181.05	5310.57	973.31	1598
1982-83	1152	2845.89	1056.77	102829	15842.78	18769.39	2605.84	2802
1985-86	968	2734.15	1892.25	80124	17989.68	20878.95	2535.14	3551
Bijnor								
1976-77	221	313.37	101.33	16170	1601.88	1928.38	295.94	2009
1979-80	222	374.59	164.99	19373	1173.10	1470.49	259.67	1475
1982-83	245	682.32	181.61	21328	3530.22	4191.73	580.79	2987
1985-86	208	578.17	283.76	18676	3464.20	4069.36	522.05	3141

Source: Annual Survey of Industries, Economics and Statistics Division.

fixed capital, working capital, total employment all went up by 1976-77. So also did the total output witness, a more than two fold increase. Value added, although registered an increase, did not go up in the same proportion. The increase being only around 56 per cent (Table 2.6).

CHAPTER 3

CHOICE OF SUGAR TECHNOLOGY

The technological process of sugar manufacturing, involving the techniques of cane crushing and juice crystallisation, has undergone radical change with developments in the field of science and technology. The techniques of cane crushing and juice crystallisation used till the late nineteenth century were of India origin and traditional in character. But the indigenous traditional technology which involved mortar and pestle and three roller mills till 1870 was the characteristic of the Indian society and district level of technological development of that time in the world. The diffusion of the new technologies from the west since the beginning of the twentieth century (specially after 1870) started changing the technological process of cane crushing and sugar manufacturing because of new technological inventions and innovations such as steam power and tools making with iron. As a result, the traditional technology of sugar manufacturing was gradually replaced by the modern technologies such as OPS and VPS with increasing population pressure and demands the question of choosing between alternative technologies arose because of output and employment considerations. Hence the question of choice of

technology concerning sugar industry now occupies one of the central themes for discussion and debate from the point of view of development and planning. Before looking forward we should have to see the definitions regarding the various technologies existing in the process of production. Few definitions on technology are given below:-

3.1 Few Definitions on Technology:¹

(i) Appropriate technology: Appropriate technology is now recognized as the generic term for a wide range of technologies characterized by any one or several of the following-features: low investment cost per work place, low capital investment per unit of output, organizational simplicity, high adaptability to a particular social or cultural environment, sparing use of natural resources, low cost of final product or high potential for employment.

(ii) Capital saving technology or light-capital technology:- a concept pioneered by congressman clarence D.Long of the US House of representatives and now Widely used by the US Agency for international development, is a technology characterized primarily by its low cost in capital and small size of the

1. Edited by marilyn carr "The At Reader: Theory and Practice in appropriate technology". (pp. 10-11) Oxford 1985 (Delhi oxford university press, Bombay, Calcutta, Madras). Taken originally- Nacelles Jequier and Gerard Blane. "The world of Appropriate technology (1983).

investment needed to create a job. Building roads with efficient labour-intensive methods embodies light-capital technologies, building them with bulldozers and scrapers does not.

The encouragement of labour-intensive technologies and industries in the manufacturing sector has frequently been recommended in recent years as an important element in employment - oriented development strategy. Under the world employment Programme has to a greater or lesser extent proposed measures of various kind, to influence factor prices and to promote research and development so as to encourage labour intensity and thus a faster rate of growth of employment in manufacturing. Nevertheless, because this is largely virgin territory for economist the existence of technically efficient labour-intensive alternatives to modern, large scale production methods has been a matter of some controversy and even scepticism (doubt).

The process of industrialisation in the developed world has shown a continuous increase in scale of production, mechanisation and automation. Small-scale activities and inferior technologies have disappeared in the course of time, with the consequence that the same product is usually manufactured by similar methods, not only within but also across developed countries. In less developed countries the same process takes place, but since many technologies are

imported from the developed countries, highly modern technologies often co-exist with traditional production techniques for the same products, Textile, for example may be produced both by handlooms as well as by large scale, mechanised textile mills.

In a neo-classical world, characterised by perfect mobility of production factors, every product in the long run, would be produced in the same way in the absence of technological progress. Only in the exceptional circumstance where factor prices are such that different factor proportions throw up the same costs, can more than one technology exist. In reality both across and within countries institutional factors limit the mobility of production factors and lead to a fragmentation of factor markets, a phenomenon that may be reinforced by certain Government policies. In other words, production factors are not priced in a uniform way, and consequently it is no surprise that the same product is found to be produced by different techniques.

The fragmentation of factor markets is strongest in the less developed parts of the world. Wage and labour income in the unorganised sectors of the economy are much lower than those prevailing in the modern sector, while the rate of interest on capital is considerably higher. The difference in factor prices is probably the most important explanation for the co-existence of different methods of production

for the same product. Another explanatory may be the taxation policy of Government, which some times discriminates against certain modes of production. Finally, primitive techniques continue to exist some times because they produce goods of inferior quality which are mainly purchased by low income groups, where as more modern techniques manufacture the same products for the wealthier sections of the population.

The application of western technologies with low employment output elasticities implies that the modern industrial sector has to grow extremely rapidly to make a significant contribution to the often severe conditions of underutilisation of labour. In the initial stages of industrial development total employment may even decrease if the modern industrial sector does away with small scale labour intensive production units. Further, the wide technological gap between modern and (more) traditional methods of production creates a highly inequitable pattern of development, since labour productivity and wage are much higher in the modern sector and capital income tends to be concentrated in fewer hands. It is therefore, desirable to search for alternative patterns of industrialisation.

The type of technology used in developed countries is extremely capital-intensive, so much so that it tends to become the prerogative of those countries which are richest and of those groups with

in the countries which are the richest. It is thus easy to see why development using western technology has been such a slow process. Hence, however large the figures of international aid from the rich to the poor countries may be it is of little help. (Providing jobs in the developing world by using advance technology is a very - very expensive business). A times through aid comes a technology that is not designed to provide jobs instead it often is designed to eliminate jobs i.e. to replace them by automatic process. It has been said and with some justification that our technologies are designed to eliminate the need for people and to maximize the need for capital. It should be noted that this is not a political criticism as such, for the economic problem is no less painful for non-capitalist countries. It is simply that the type of technology we use places great emphasis on the economy of large scale operations and is often poorly adapted to decentralized, local situations. In this sense, contemporary technology is as badly suited to accelerating development as any that can be imagined.

In the developing countries, the question of technological choice is far less dramatic than it is prevailing in developed countries. It is nevertheless, a question that touches much closer to the every day life of the poor countries and is central to their very hope for development. At the

heart of the problem of economic development lies the question of the best way to combine the existing resources in a country, both so as to tackle the present misery of poverty and to form a broad base from which future growth can occur. The way in which the various resources land, capital, labour and skills are combined in the technology used in a particular process. But the prevalent technology is not merely an out growth of the existing levels of resources. It also reflects general economic policies, political and managerial decisions, prestige considerations, research and development and the case of transfer of technology from else where. **THUS THE CHOICE OF TECHNOLOGY IS COMPLEX, BUT ALSO IS CRITICAL TO THE NATURE OF THE DEVELOPMENT PROCESS.²**

3.2 Sugar Processing Technologies:

Three methods generally use for manufacturing of sugar in the country are (i) modern Vacuum Pan Sulphitation (VPS), (ii) Open Pan Sulphitation (OPS), and (iii) refining of Gur. The five main stages in the production process, which are common to all the processes are:-

2. SARAH JACKSON "Economically Appropriate technologies for developing countries : A Survey". in Pradeep K. Ghosh, Editor "Appropriate technology in Third World Development (p. 73.)

- (1) Extraction of Juice - which is a separation of the juice from the fibre by pressure;
- (2) Clarification of Juice - clarification and removal of impurities that interfere with the subsequent evaporation and crystallisation;
- (3) Evaporation of Juice in to massecuite - removal of the high percentage of the water by evaporation;
- (4) Crystallisation of the massecuite - Conversion of sugar from a dissolved condition in to crustal form;
- (5) Separation of molasses from the sugar crystals - separation of crystal sugar from the mother liquor or molasses.

The juice is extracted by crushing the cane between rotating, grooved rollers. The residual is called bagasse and can be used for a number of purposes. The juice extracted has to be purified in order to facilitate crystallisation and to prevent caramelisation. The clarified juice is boiled and evaporated to form massecuite, a thick syrup-like mass which starts to crystallise as soon as a critical temperature (i.e. about 150 degree fahrenheit) is reached. After crystallisation the sugar crystals are separated from the molasses and dried. The molasses can be used as an input for distilleries to produce alcohol and or as animal feed.

The basic principle of sugar production is to recover as much sucrose as is contained in the sugarcane. In terms of weight, cane contains 12 to 15 percent sucrose, depending on the quality of the cane. The efficiency of the production process is usually expressed by the weight of sugar obtained divided by the weight of sugarcane crushed and is called the RECOVERY RATE. The two stages during which the most of sucrose gets lost in the sugar processing are (1) extraction and (2) evaporation. It is not possible to extract all the sucrose from cane (whatever pressure may be exerted). Even in large scale mills it is possible to recover only 90 to 95 percent of the sucrose.

There are three sweetening agents that get manufactured from cane in India. These are gur, khandsari sugar, and mill sugar. Gur is solidified, clarified cane juice which still contains molasses. It is hard, crystalline and its colour ranges from golden yellow to brownish yellow. Its sucrose content varies from 65 to 85 percent and the recovery rate of the production process is about 10 percent.

Khandsari sugar is a granulated, crystallised sugar which contains 94 to 98 percent sucrose. The recovery rate of the traditional process varies between 4.5 and 5.5 percent, whereas the modernised process attains a rate of 6.5 to 7.5 percent. This improved process, commonly known as open pan

sulphitation (OPS) method, is very similar with clarification system of large scale modern technology. Before boiling, the juice is clarified by means of liming and sulphitation. Recovery and the quality of the sugar obtained, is far superior to that of the traditional method. first quality of OPS Sugar can hardly be distinguished from white cristal sugar produced by sugar mills. The capacity of the OPS factories varies from 50 to 300 tonnes per day and the larger factories use six or some time nine rather hydraulic crushers; in the larger units several operations are mechanised.

The sugar produced by Indian sugar mills is officially called Plantation white sugar. This large scale sugar making method differs from OPS in juice boiling in vacuum pans so this modern sugar mills or plants are also known as vacuum pan sulphitation (VPS) plants. While plantation sugar is, however, directly produced from the cane. It has a sucrose content of 99.5 percent and the recovery rate varies from 8.5 percent to 12.5 percent depending up on the sucrose content of the cane and the efficiency of the factory.

3.3 Juice Extraction Methods in VPS and OPS:

In the large-scale sector sugar cane is crushed by various tandems of three-roller hydraulic crushers of high capacity. During the crushing, water is spread over the cane in order to dissolve the sucrose

in the crushed cane. This method, called imbibition, is necessary since the cane dries up during the crushing and sucrose can not be extracted only by pressing. This imbibition is not used in OPS plants as the addition of water to the juice would increase the boiling time and thus the consumption of fuel, the higher fuel costs are not compensated by the increased sucrose recovery. Apart from fuel costs, the longer boiling time would increase inversion and therefore also the rate of recovery.

In improved khandsari units (OPS), sugar cane is crushed by three different size of crushers, namely (i) 10" x 12" crusher (ii) 11" x 14" crusher (iii) 13" x 18" crusher. The first figure indicates the diameter and the second the length of the rollers. Each crusher has a fixed crushing capacity which increases with the size of the crusher. Capacity which increases with the size of the crusher. The smallest crusher has an average crushing capacity of around 3.5 tonnes per hour while the two bigger size cashers have a crushing capacity of around 5 and 9 tones per hours respectively. In OPS unit the crusher is placed horizontally, while the crusher is placed vertically in the case of a 'khara kolhu'. The crushing capacity of horizontal crusher is relatively high with that of vertical crusher or khara kolhu.

Khara kolhu is household unit utilising mainly family labour. Prior to 1977 one had to get a license

for setting up a khara kolhu, which is nothing but a power crusher with its rollers placed vertically instead of horizontally as in case of the rollers of khandsari unit. Thus its crushing capacity is reduced. In 1977 the Government made an alteration in the policy and make free from formalities of licensing and registration for khara kolhu. Although, now all individuals setting up a khara kolhu are expected to register their names at the District Board, but in practice there are much more units than the registration figures indicate. It is mainly the road side units which get registered while those in the interior escape the notice of the District Board Officials. In fact since the District Board has no control over these units they do not even take pain to find out the exact number.

3.4 Production Process of VPS:

Much has been indicated above, about the main stages in the production process which are common to VPS and OPS techniques. The beginning process of sugar manufacture is called Milling Process under which cane is crushed and juice is extracted. The raw juice is limed in order to neutralise the juice to litmus. Clarification of juice is done by simple defecation, that is only be liming and heat treatment as it is generally followed in case of manufacturing raw sugar for export. There are two processes for

clarifying juice - (a) Sulphitation process, and (b) Carbonation process. Under sulphitation process, juice is clarified with lime and sulphur dioxide gas. The sulphur dioxide gas, got from the heating of good quality sulphure, in sulphur furnaces, is passed through scrubbers and then through the juice forming sulphite of lime. Under carbonation process, the raw juice is heated to about 150 degrees Fahrenheit or 65° to 70° C. and a correct amount of lime is added. Carbon dioxide gas is then bubbled through the juice until the juice is neutral to phenolphthalein. It is then heated to boiling point and filtered. The juice is sometimes carbonated twice to give better purity. The juice after being clarified contains about 20 percent of sugar. Sugar produced under the carbonation process is of superior quality.

3.5 Production process of OPS:

The smaller, three roller crushers are manually fed by two workers, while a third worker standing behind the crusher returns the bigger pieces in order to increase the rate of juice extraction. Two pair of workers carry away the bagasse in baskets to the drying fields out side the factory premises. The large six-roller hydraulic crushers are fed by power-driven chains which lead the cane via shredders and cutters to the first set of three rollers and subsequently to the first set of three rollers and

subsequently to the second set of three rollers. In the more efficient units the bagasse is also removed by a chain to the bullock-carts, which carry it to the drying fields. The extracted juice is collected in juice tanks through strainers.

From the juice tanks the raw juice is pumped in to the sulphitation tanks where lime is added to the juice to reduce its acidity and into which sulphur gas is also released under pressure. The acidity has to be neutralised to prevent sucrose losses during boiling and the sulphur gas is added for clarification purposes. When the sulphitation is completed, the juice falls due to gravity in to the sulphitation bel which is situated under the tanks. Here it is heated to a temprature of 100° c, and then pumped to the setting tanks, where the impurities sink gradually to the bottom. The clarified juice is conveyed to the juice boiling pans and the bottom layer of muddy juice is first filtered before it enters the pans. The clear juice is boiled and evaporated in bels, which consist of five or six pans placed like a staircase on top of an underground tunnel heated by burning dried bagasse. Usually, three persons work at one bel; the first is an experienced boilor who knows when to shift the juice from one pan to the other and when the concentrated juice or Rab is ready for crystallisation. He is assisted by a helper; the

third worker carries away the rab in buckets to the crystallisers.

The crystallisers are U-shaped tanks where the rab is mechanically stirred to facilitate the formation of sugar crystals. After about 36 hours the rab is ready and carried in buckets to the centrifuges, which separate the molasses from the sugar crystals. The wet sugar is packed in 100 kg bags or in tin constrainers and usually carried on the back of a worker to the drying platform, where it is dried in sun. Usually sun drying is preferred as this makes the sugar whiter and brighter but in larger and more efficient plants, rotary driers used. The rotary driers, dried the wet sugar and graded in to two or three qualities a sugar automatically.

The molasses is reboiled in smaller bals and crystallised, often in tanks of smaller size. The sugar obtained in the second round is called second sugar and has a lower quality in terms of colour, crystal size and taste. The molasses obtained in the second round is also boiled, it is not put in crystallisers but in large masonry tanks, where the crystals develop under static conditions over a period of a few months. After the crushing season and after the on set of the monsoon i.e. in July or August, the molasses of the second round is centrifuged to obtain the third sugar. This sugar is not suitable for direct consumption and is therefore sold to small

plants which specialise in refining it or to sweet makers or even to sugar mills which work under capacity in the beginning of the season. Several units, however, do not make third sugar but process the second molasses in to 'black gur', which is sold to sweet makers, this practice is prevalent particularly when the gur price is high and if the entrepreneur has an urgent need for cash.

3.6 A Review of Literature on Choice of Sugar Technology:

The co-existence of various cane processing and sugar production technologies has been the subject of continuous study and debate in India since the beginning of this century. As early as in 1920 the Indian sugar committee set up to study the desirability of devising protection measures against sugar imports, discussed the merits and demerits of the Khandsari industry vis-a-vis the sugar mills. Since then all official documents on the sugar industry have been replete with analysis of and recommendations on the integration of the three competitors for sugarcane: The sugar mills, the Khandsari industry and the Gur sector. In the late seventies the such studies become popular and received increasing attention from abroad. International labour organisation (ILO) was the first organisation to show interest, followed by United Nations Industrial Development Organisation (UNIDO) and

foreign research institute in particular the Livingstone Institute of the University of Glasgow. The debate was mainly focussed on the improved khandsari process, also denoted by the open pan sulphitation process (OPS).

In India, basically two points of views prevail with respect to the OPS method. The first current of thought is represented by the National Sugar Institute at Kanpur. According Gupta K.K. and Others³, the vacuum pan sulphitation process (VPS) is superior, both technically and economically, to other technologies, but since shortage of investment funds prevents crushing all the cane by this method, even in the medium and long run, less efficient techniques have to be accepted in order to ensure that the demand of the population for sweetening agents is satisfied. This opinion has been challenged by representatives of the Planning Research and Action Division (PRAD) and of the Appropriate Technology Development Association (ATDA) both located in Lucknow, by Garg, M.K. 1979⁴ and PRAI 1968⁵. While recognising the technical

3. Gupta, K.K., N.C. Jain and N.A. Ramaiah "Appropriate technology for production of sugar and other sweetening agents," in Appropriate Industrial technology for Sugar, UNIDO, New York. (1980) pp. 75-76.
4. Garg M.K., Mini Sugar - Project Proposal and Feasibility Report, Appropriate technology Development Association, Lucknow., (1979).
5. PRAI, Report of the fourth technical seminar on the open pan sugar manufacture (24-26 Sept. 1966), Planning Research and Action Institute

superiority of the VPS process, they suggest that the lower recovery and thus higher cane costs of OPS would be compensated by the lower capital costs and the higher degree of employment generation. They further refer to other advantages, such as better dispersal of economic activity and linkages at the local level. Even if these benefits do not fully outweigh the lower recovery, they believe that the OPS method can be improved by technological innovations, which might even make OPS superior to VPS.

The protagonists of the OPS process received welcome support from Baron⁶ C.G., who concluded in an ILO study that the present value of the costs of OPS and VPS would be equal for a crushing season of 150 days, while the costs of OPS would be lower for seasons of shorter duration. If the seasons last 200 days the social costs of sugar mill production are lower either recovery rate. Therefore, from the difference in recovery rates among regions, the degree of capacity utilisation is vital, sugar mills are not justifiable if they crush cane for less than 150 days per season: above 150 days they become justifiable as long as weight is not attached to the value of a wider income (and employment) distribution. As shown by United Nations Industrial Development Organisation

Lucknow.

6. Bara C.G. "Sugar processing techniques in India, in A.S. Bhalla ed., Technology and Employment in Industry, ILO, Geneva (1975).

(UNIDO)⁷, assigning a shadow price to capital, does not affect the ratio of net present value (NPV) between different projects and leaves the signs of the NPVs unchanged, if the savings behaviour does not change in the future . Since the net benefits of VPS exceed those of OPS, application of a shadow price of capital would lead to an increase in the absolute difference between the NPVs of both processes. Surprisingly, this methodological error has remained unnoticed by the various authors who have contributed to the debate.

The Appropriate technology Development Association and Planning Research and Action Division (ATDA/PRAD) view was reinforced when the Planning Commission proposed imposing a ban on the licensing of new sugar mills in the Draft Five Year Plan 1978-83. This decision was expressed in the following words. "The alternative technologies available for the production of white sugar consistent with desirable capital employment parameters show that future demand for sweetening agents, after allowing for fuller utilisation of the existing and licensed sugar mills, can be met by necessary expansion through open pan sulphitation (OPS) Khandsari Plants. It is proposed to work out the policy framework for the further expansion of the sugar industry in the light of these

7. UNIDO. Guideline for project Evaluation. UNIDO New York, (1972).

studies. For the time being, therefore, no new sugar mills will be licensed, although expansions of existing units may not be ruled out where this is necessary for maintaining their viability".⁸

The proposal of the Planning Commission was partly based on a linear programming exercise, carried out by Raj Krishna with Reddy C.R.⁹ and Rangarajan and Karlo¹⁰ in which the distribution of the increase in sugar production during the plan period over OPS and VPS was determined by minimising a cost function subject to a minimum constraint for output and employment and a maximum constraint for capital. While various values for the right-hand variables were used in the main variant 68 percent of the increase in sugar production was to be allocated to VPS and OPS getting the remaining 32 percent.

When a new Government came to power in 1980, a new plan was prepared for the period 1980-85, in which the earlier proposal was deleted, this was heavily surprising since India was facing one of its worst post-independence sugar crises at the time of preparation of the plan. Sugarcane was in short

8. Planning Commission. Draft Five Year Plan 1978-83. New Delhi, (1978).

9. Reddy, C.R. and R. Krishna, " Choice of technology in the sugar industry, Planning Commission, Project Appraisal Division (Mimeo) (1978).

10. Rangarajan ,C. and A.H. Karlo, " choice of technology in the sugar industry, economic and political weekly Vol. 15 (1980)pp.333-336.

supply and sugar prices rose to record levels, a situation which hardened the attitude of policy makers to the cane-wasting Khandsari industry.

The most recent support for OPS has come from Kaplinsky¹¹", who admits that OPS is not viable on the basis of its present method of operation. He believes, that technological improvements will renders OPS sufficiently cost efficient to withstand competition from VPS under equal conditions. This is true that the OPS units are "cane wasters" by comparison with the mills, because of their lower recovery rate. This is a valid argument but clearly a very limited one, for the mills may equally well be dubbed "capital wasters"¹² especially in a seasons of low cane aim production.

A remarkable feature of the debate on sugar technology is the scant attention paid to the Gur sector. Obviously, gur is not a direct substitute for sugar, but it can be taken for granted that the production of OPS sugar is much superior to gur manufacturing. The higher profitability of OPS sector can sell all its produce i.e. Sugar, Khandsari, Molasses and Badda Gur at an artificially high price on the free market. Further, the public distribution

11. Kaplinsky, R. Sugar Processing - The development of a Third World Technology, ITDG, London (1984).

12. Baron, C.G. " Sugar processing techniques in India, in A.S. Bhalla ed. Technology and employment in Industry, ILO, Geneva, (1975).

of cheap sugar is likely to diminish the demand for sugar and thus its price.

The debate on sugar technology assumed global dimensions when international organisations such as the ILO and UNIDO and foreign research institute got involved. One of the main issue in the discussion was the appropriateness of the OPS process for African countries. One of the first study Forsyth¹³, examined the relationship between scale and technology and came forth with the result that OPS was only desirable at the smaller scales. This implied that OPS should be applied only when cane supply is so deficient or dispersed that a sugar mill of larger capacity would not be viable. This situation is of limited relevance for India, where sugarcane is cultivated intensively in a large number of regions. It would seem somewhat unlikely that in African countries with less pressure on land compared to Asia, no land could be made available to supply sugarcane to a sugar mill of a capacity of about 1500 tones of cane per day. And if this was really so importing sugar might be a better proposition. On the other hand sugar cane is a crop, the production of which fluctuates from year to year depending upon the weather, rainfall and diversion of acreage to other crops which depends on the price of cane declared by the Government vis-a-vis of other

13. Forsyth, D.J.C., Appropriate technology in sugar manufacturing, world Development, Vol. 5 (1977) pp. 189-202.

crops. If all these conditions favour to this crop then the output is so large that it is difficult for the mills to crush all the sugarcane and in such years its the OPS, Khandsari units that save the wastage of sugar cane crop. In such years OPS works as "cane-savior" rather than "cane wasters", at the National level.

The uncompromising view of Forsyth evoked reaction from others who were more supportive of small-scale enterprises. Hagelberg¹⁴ questioned the database and assumptions but was unconvincing in his rebuttal (see Forsyth)¹⁵. More substantial contribution were made by Bhat and Duguid¹⁶ and in particular by Alpine¹⁷ and Pickett. The latter compared both technologies under the assumption that they would be used in a plantation system. They considered, therefore, different can cultivation techniques in combination with the processing techniques. Their basic assumption was that OPS could

14. Hagelberg, G.B. "Appropriate technology in sugar manufacturing - a rebuttal world development vol. 7 (1979) pp. 893 - 899.
15. Forsyth, D.J.C. "Appropriate technology in sugar manufacturing; a reply, world development, vol 8. (1980)pp. 165-166.
16. Bhat, B.A. and F. Duguid, "Appropriate technology in cane-sugar production, in appropriate industrial technology for sugar, UNIDO, New Yard, (1980).
17. Alpine, R. and J. Pickett, "More on Appropriate Technology in sugar manufacturing, world Development, vol.8 (1980) pp. 167-174.

be supplied with cane of lower yield (as a consequence of less inputs like fertiliser) that was cultivated and harvested in a labour-intensive way. This would not be possible for VPS as the lower yield would increase the area of sugarcane to such an extent that transportation costs would become prohibitive, given the bad road condition. It was further assumed that the cane delivered to the mill had to be harvested mechanically. It was found that in rain-fed areas, where land is cheap relative to capital, growing cane with less capital inputs over a wider area would reduce the cost of cane to such an extent that OPS had a higher net present value than VPS if the season was long. In irrigated areas with a long season VPS was indeed superior but not enough to discard OPS at once. It was not examined, however, whether the return on growing cane with low capital inputs was higher than that of alternative crops. Their results are, however, unlikely to apply to a landscarce country like India.

United Nations Industrial Development Organisation (UNIDO) organised a seminar at Nairobi in 1977 on the implications of technological choice in the African sugar industry. The suitability of OPS under African conditions was an important topic in the papers presented and in the discussions. While there was some scepticism regarding OPS, a study of the OPS process under Indian conditions was nevertheless

recommended with a view to establishing its appropriateness for Africa. It was further proposed that a number of pilot OPS units be started in certain African countries in order to evaluate the operation of these plants¹⁸.

As a sequel to this seminar, a further seminar was held in India in 1978, where the central theme of the discussion was the pros and cons of both OPS and VPS. The seminar concluded that OPS would be 'appropriate to situations characterised by conditions such as mixed agricultural cropping pattern, small domestic markets, inadequate infrastructure, capital scarcity and widespread unemployment or underemployment'¹⁹.

The proposal of the Nairobi seminar to install a few pilot OPS plants was implemented and an Indian manufacturer exported equipment to East Africa. Kaplinsky contains an assessment of the functioning of OPS units in Kenya, Four OPS units were built in Indonesia.

Another study worth mentioning was conducted by Delasanta and Morgan in Pakistan. They compared four technologies; VPS, OPS, modernised gur making and two

18. UNIDO/UNEP (1977) final report of the joint UNIDO/UNEP seminar on the Implication of technology choice in the African industry, 18-22 April 1977, Nairobi (memo) p.13.

19. UNIDO (1980). Appropriate, Industrial Technology for sugar (Monographs on Appropriate industrial technology). No. 8, New York p.9.

bullock-driven crushing units, one making traditional khandsari and the other Gur. The comparison was made on the basis of the Little-Mirrlees method of evaluation and had used shadow price for all inputs and outputs in a crucial manner. Only VPS and the improved Gur plant showed a positive net present value (NPV). The value of the Gur unit exceeded that of VPS by such a large margin that the former was considered the most appropriate technology²⁰.

While there is some similarity between India and Pakistan in the area of sugarcane processing. The parameters for VPS do not tally, especially those prevailing in western Uttar Pradesh or even in the country at large. In particular, the recovery rate of 8.5 percent is considerably lower than the Indian figure. Further, not all scales of production considered are representative of the Indian conditions, where bullock-driven crusher units account for a minor proportion of total cane crushed. The modernised gur unit refers to a hypothetical unit which uses a hydraulic crusher of the size applied in the OPS process. In India hydraulic crushing in gur manufacturing is an exception, since the entrepreneurs who can afford to set up hydraulic crushing plants prefer to produce Khandsari, which yield much higher profits. On closer examination, it appears that the

20. Delasanta, D.W. and R.P. Morgan (1980). The choice of sugarcane processing techniques for Pakistan, world development vol.8 pp. 725-739.

favorable conclusion with respect to gur unit has emerged primarily on account of to be contributed to the assumption of a recovery of 14 percent. If this rate were to be 12 percent, which is more realistic estimate, the NPVs of VPS and gur would hardly differ.

Some comparative economic data on large scale and mini sugar technology under Indian conditions computed by M.K. Garg²¹ UNIDO, (1982), and also a comparative analysis of the productivity of the two technology is presented by him in table 3.1 and 3.2 respectively.

The data show that mini technology would produce 2.37 times more sugar and create 10.3 times more jobs for the same capital cost than would large-scale technology. However, experience indicate that the efficiency of large-scale sugar technology improves if the unit working periods are extended.

To produce one unit of sugar, mini technology is superior to large-scale technology in all respects but mini technology requires 13.33 units of cane as against 10 by large units.

This difference will be minimized when recent technological innovations are put in to commercial use. The development of an expeller for increasing crushing efficiency will increase yield by 0.7 percent to 8.2 per cent and manufacture of liquid sugar out of

21. Garg, M.K. 'Monographs on Appropriate Industrial technology, UNIDO (1982), in marilyn Carrs ed. The at reader, theory and practice in appropriate technology (1985) pp. 114-115.

Table 3.1
Comparative Data on Large-Scale and Mini Sugar Technology

Item (1)	Large-Scale (2)	Mini (3)
Total Capital available for investments (Rs. million)	60	60
Capital required for installation of one unit (Rs. million)	60	01.3
Number of units which can be set up with available investments capital	1	46
Working days	120	100
Total sugar output (t/a)	14,500	34,550
Persons employed	900	9,292

Source: Garg, M.K. 'Monographs on Appropriate Industrial technology', UNIDO (1982), in Marilyn Carr's ed. The at reader, Theory and Practice in Appropriate Technology (1985), p. 114.

Table 3.2
Comparative Analysis of the Productivity of the Two Technologies

Item (1)	Large-Scale (2)	Mini (3a)	Mini (3b)
Working days	160	120	100
Cost of 100 quintals of cane (Rs)	1250	1250	1250
Cost of processing 100 quintals of cane (Rs)	1032/2282	585/1835	632/1882
Total sugar Produced (Quintals)	9.6	7.5	7.5
Cost of sugar per quintals (Rs)	238	243	251

Source: Garg, M.K. 'Monographs on Appropriate Industrial technology', UNIDO (1982), in Marilyn Carr's ed. The at reader, Theory and Practice in Appropriate Technology (1985), p. 114.

khandsari molasses will raise it to about 9.2 percent. It should also be emphasized that the sugar produced by mini technology is of identical quality with the sugar produced by large scale technology. At the same time mini sugar was crushing 10 percent of the total sugarcane grown in India and produced about one million tonnes of sugar annually.

Regarding OPS plants Tyagi, B.N.²² emphasizes that the state had a capacity to crush only about 1/3 of the total production in the modern factory sector and when the production of sugarcane is increasing at the rate of 16 lakh tones per annum, the Khandsari unit do have a role to play. Khandsari industry is not in competition with sugar industry it is playing supplementing role and acts as a safety valve for the farmers, particularly in the years of large sugarcane production.

From the above it is clear that OPS units are labour intensive, require less capital to produce sugar as compare with VPS mills. As labour is surplus in India and Capital resources are very limited, OPS technology appears to be superior and more suitable for this country. As far as cane consumption or less recovery is concerned in OPS, it only highlights the need for concerted efforts on research for evolving appropriate varieties and improving the technology so that the recovery in Khandsari improves considerably. Experience in this regard do indicate the possibility

22. Tyagi, B.N. "Sugar cane economy of Uttar Pradesh, occasional paper 2, CADR, Lucknow, 1989, pp.17-18.

of increasing its recovery from 6 percent to 7 or 7.5 percent. One percent increase in the efficiency would result in additional quantity one lakh tones of sugar production worth Rs. 70 crores.

3.7 Sugar and Khandsari Industry in Uttar Pradesh:

The sugar units of the state have grown gradually over the years. There were 68 units in 1950-51, 71 units in 1960-61, 74 units in 1973-74, 90 units in 1980-81 and 101 units were in 1985-86. The total number of sugar factories and sugar factories worked during 1950-51 to 1987-88, shown in the table 3.3. It would be seen from graph 1 that number of sugar factories have increased rather sharply after 1983-84. (Graph I) Further, sector wise sugar mills in Uttar Pradesh since 1979-80 to 1984-85 has been given in Table 3.4.

Table 3.4
Sector-wise Distribution of Sugar Mills in Uttar Pradesh

S.No.	Sector	1979-80	1980-81	1981-82	1982-83	1983-84	1984-85
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
1	Corporation	19	19	19	19	19	30
2	Co-operative	16	17	18	19	21	26
3	Receiver ship	10	10	11	10	10	-
4	Castodian	5	5	5	5	5	5
5	Joint Stock	39	39	38	39	39	38
Total State		89	90	91	92	94	99

(Source: Main statistics of Sugarcane and Sugar Industry, 1985).

Table 3.3

Total Number of Sugar factories and worked
during 1950-51 to 1987-88 in Uttar Pradesh

Year	Joint coop Stock	Public Sector	Total Worked	Total Number of Sugar Factories
(1)	(2)	(3)	(4)	(5)
1950-51	68	-	68	68
1955-56	68	-	68	68
1960-61	69	2	71	71
1965-66	67	4	71	71
1968-69	67	4	71	71
1973-74	69	5	74	74
1978-79	73	15	88	88
1979-80	72	16	88	89
1980-81	73	17	90	90
1981-82	73	18	91	91
1982-83	72	19	91	92
1983-84	72	21	93	94
1984-85	72	26	98	99
1985-86	72	28	100	101
1986-87	72	29	101	102
1987-88	74	29	103	104
1988-89	74	29	103	104

Source : Indian Sugar Year Book (1984-85 & 1987-88 & 1989-90)

GRAPH I
Number of Sugar factories in Uttar Pradesh

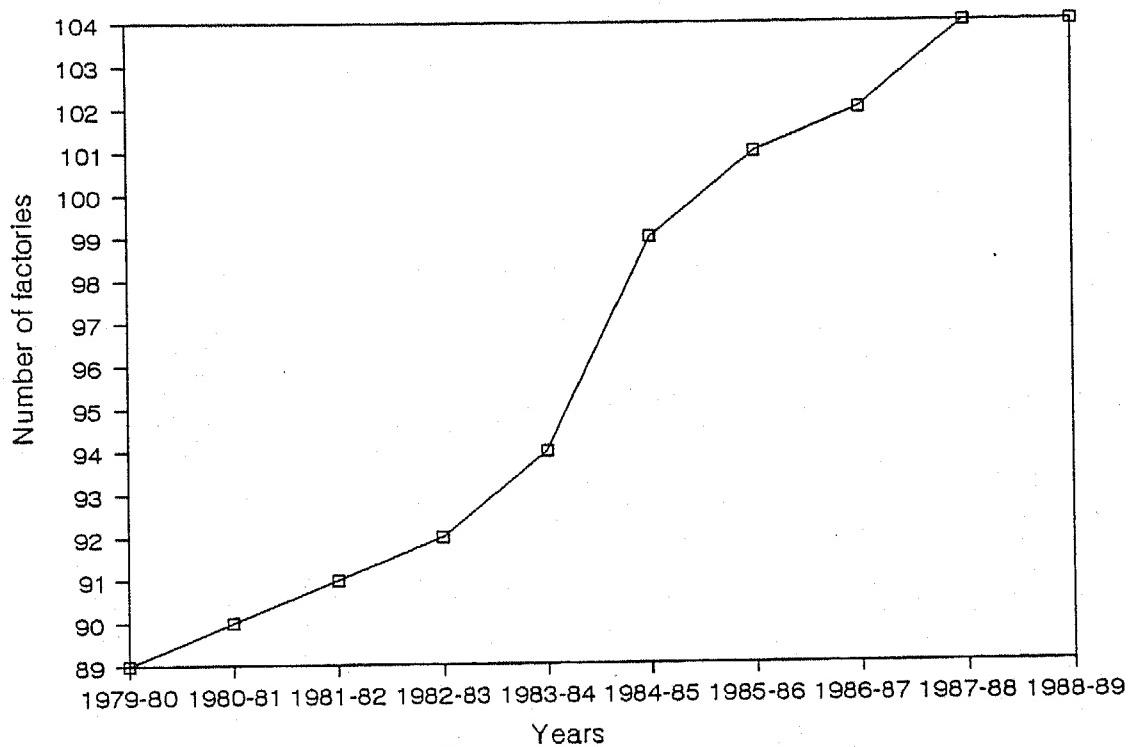


Table 3.5 shows, the total number of khandsari units from the year 1975-76 to 1989-90. This table not only gives number of licensed units, working units but also gives number of units separately as sulphur and non sulphur units in the Uttar Pradesh State. However, it is quite interesting to note that despite the fact that the total number of khandsari units have shown a declining trend, (Graph II) the total quantum of sugarcane crushed has increased over the years. Between 1974-75 and 1989-90 the number of units were reduced to less than half yet the total quantity of sugarcane crushed more than doubled and production of khandsari sugar has increased (Graph III). This is possibly so because despite the problems of the khandsari sector, those who have survived are more efficient units. They have increased their crushing capacity by increasing the total daily crushing time and by increasing the size and number of crushers (Table 3.6). The declining trend in total sugarcane crushed and decline in production by khandsari units after 1986-87 is a reflection of serious conditions emerging in khandsari industry. This may have happened, also due to khandsari units declining and there surviving may have already achieved their maximum cane crushing capacity and crushing time. At this stage if any unit of khandsari industry stopped functioning due to any reason, it will create an adverse effect on quantity of sugarcan crushed and

Table 3.5

Sulphur & Non - Sulphur units of Khandsari in Uttar Pradesh

Year	Licensed Units			Working Units		
	Sulphur	Non Sulphur	Total	Sulphur	Non Sulphur	Total
(1)	(2)	(3)	(4)	(5)	(6)	(7)
1975-76	1219	2858	4077	1038	2462	3500
1976-77	1189	2265	3450	1033	2103	3136
1977-78	1420	2686	4106	1075	1884	2959
1978-79	1106	2069	3175	812	1597	2409
1979-80	882	1857	2739	769	1551	2320
1980-81	1010	1856	2875	944	1692	2636
1981-82	997	1816	2813	943	1548	2501
1982-83	1039	1722	2761	883	1301	2184
1983-84	905	1469	2374	830	1211	2041
1984-85	818	1259	2077	726	1082	1808
1985-86	777	1163	1940	713	1031	1744
1986-87	746	1128	1874	714	1053	1767
1987-88	N.A.	N.A.	1815	N.A.	N.A.	1666
1988-89	N.A.	N.A.	1744	N.A.	N.A.	1600
1989-90	646	995	1641	627	925	1552

Source: Cane Commissioner's office, Lucknow.

GRAPH II
Number of Khandsari units in Uttar Pradesh

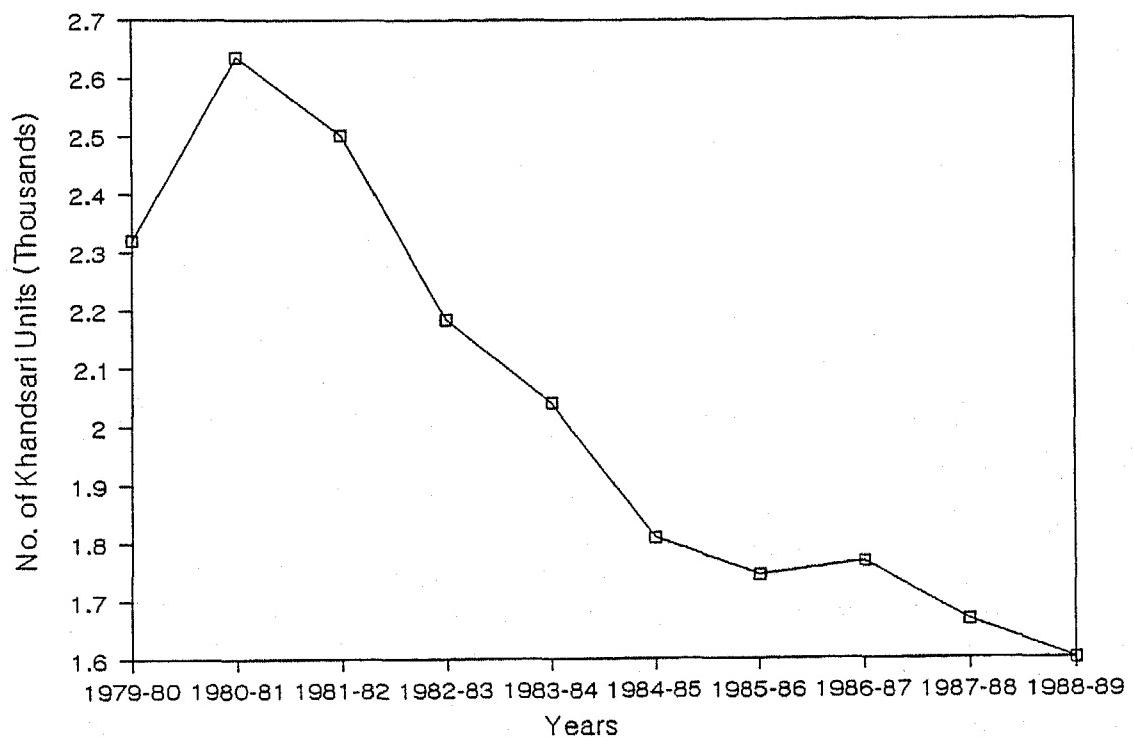


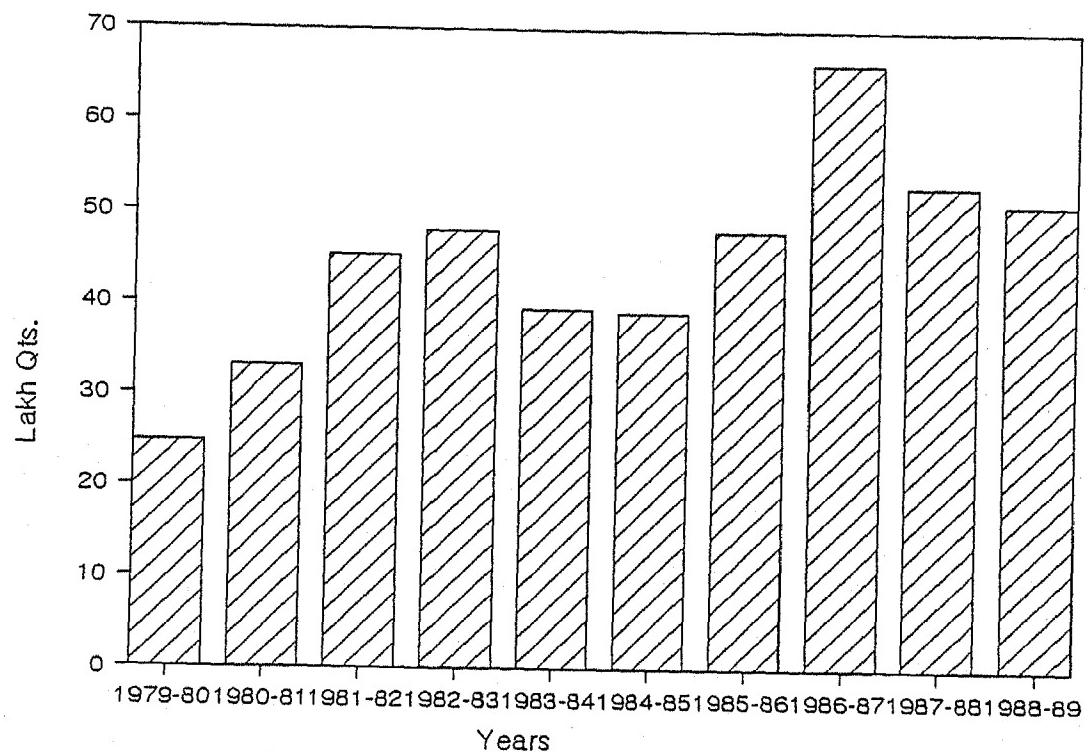
Table - 3.6

Data Relating to Khandsari units of Uttar Pradesh

Year (1)	Licensed units (2)	Working units (3)	Cane crushed (Lakh Qt) (4)	Khandsari Production (Lakh Qt) (5)	Price of cane per Qt.(Rs.) Mini (6)	Maxi
1974-75	4555	3863	542.57	24.85	8.00	18.00
1975-76	4077	3500	550.20	23.06	8.00	18.00
1976-77	3450	3136	671.07	27.51	8.00	18.00
1977-78	4106	2959	1056.18	45.89	8.00	18.00
1978-79	3175	2409	562.99	25.06	9.00	20.00
1979-80	2739	2320	555.56	24.77	9.00	20.00
1980-81	2875	2636	805.62	33.09	10.00	22.00
1981-82	2813	2501	901.48	45.25	10.00	22.00
1982-83	2761	2184	972.72	48.01	8.00	25.00
1983-84	2374	2041	909.97	39.42	8.00	21.00
1984-85	2077	1808	828.81	39.00	10.00	30.00
1985-86	1940	1744	1021.27	48.00	13.00	33.00
1986-87	1874	1767	1283.24	66.35	10.00	33.29
1987-88	1815	1666	1254.54	53.05	10.00	29.00
1988-89	1744	1600	1199.33	51.04	15.00	40.00
1989-90	1641	1552	1119.93	51.14	18.00	50.00

Source: Cane Commissioner's Office, Lucknow.

GRAPH III
Production of Khandsari Sugar in Uttar Pradesh



sugar production of khandsari units in the state as a whole. So at this stage of khandsari industry it is not only sufficient to check in fall of khandsari units but also important that Government should provide them a proper assurance and assistant in terms to fixed a reserved area for the khandsari units as Government has fixed a reserved area for the sugar mills to assured of their came supply. More finances are required to the old khandsari units for their renovation and maintenance of the plant. These finances must be provided by the Government as much as required in the industry.

CHAPTER 4

FUTURE SCENARIO: FORECASTS ABOUT THE INDUSTRY

India, the home of Sugarcane and Sugar manufacturing had to face serious competition previously and it is only after the protection that was granted in 1932 that the Sugar Industry in India made a rapid development. The number of Sugar factories increased from 20 in 1930-31 to 139 in 1949-50 and total Sugar Production from 1,20,000 tones to 9,95,000 tonnes during the same period. This phenomenal rise in both the number of factories and the production of sugar led to almost self sufficiency in India.

4.1. Trend of Sugar Production In India:

The imports of Sugar which amounted to about 8 lakh tonnes in 1930-31 were also almost stopped after (1936-37)¹. The sugar industry was granted protection till 1950. Since independence their has been an overall increasing trend in sugar production in India but like other agro Industries, this industry has been subject to wide and sometimes violent fluctuations.

One of the main reason for this is that the raw

1. Vidya Sagar, "Sugar Crisis in India: Proper Direction needed", The Economic Times, Calcutta Edition, dt. 8-7-1985.

material of this Industry i.e. sugarcane displace large inter year fluctuations mainly on account of weather, sometimes, it suffers from drought and sometimes from floods and heavy rains. Other factors responsible for these fluctuation are Government policies, prices, market conditions etc. It is therefore, seen that an upward trend in growth of production has not been very smooth. It is clear from Table 4.1, overall trend of production is rising one. During the period 1970-71 to 1988-89 the production of sugar in the country has increased at a rate of 4.58 per cent per annum.

Table 4.1 indicated that the production trend of Sugar is extremely irregular. For example, in 1977-78 the total Sugar Production in India was 64.57 lakh tonnes which fell to an abnormally low figure of 38.50 lakh tonnes in 1978-80 and again raise to a record level of 84.36 Lakh tonnes in 1981-82 and then came down to 59.17 Lakh tonnes in 1983-84 and again increased to 61.43 lakh tonnes in 1984-85. The coefficient of variation in sugar production during the period 1970-71 to 1988-89 works out at 32.30.

4.2 Trend of Sugar Consumption In India:

Not only the Sugar production but the consumption too has been rising and in fact the rate of rise in consumption has been almost consistently more than the rate of rise in production. Another most important

Table 4.1
All India Production of Sugar

		(in Lakh Tonnes)	
Year	Production	Year	Production
(1)	(2)	(3)	(4)
1950-51	11.00	1951-52	14.74
1953-54	9.85	1954-55	15.66
1955-56	18.34	1956-57	19.98
1957-58	19.46	1958-59	18.89
1959-60	23.84	1960-61	30.28
1961-62	27.30	1962-63	21.35
1963-64	25.62	1964-65	32.32
1965-66	35.72	1966-67	21.59
1967-68	22.43	1968-69	35.58
1969-70	42.61	1970-71	37.40
1971-72	31.08	1972-73	38.72
1973-74	39.48	1974-75	47.95
1975-76	42.62	1976-77	48.40
1977-78	64.57	1978-79	58.42
1979-80	38.58	1980-81	51.47
1981-82	84.36	1982-83	82.30
1983-84	59.17	1984-85	61.43
1985-86	70.16	1986-87	85.01
1987-88	91.10	1988-89	87.52

Source: Indian Sugar Year Book, vol. 1, Indian sugar Mills Association, (1987-88, 89-90)

thing to note is whereas the production has a fluctuating trend, the consumption of sugar is generally on the rise persistently imbalance between production and consumption of sugar calls for policies which would stabilise the availability of Sugar on the one hand and its domestic and export demand on the other. As a consequence of higher increase in domestic consumption over production the surplus left for export has registered a declining trend. In certain years, it has turned out to be even negative, necessitating imports to cover the deficits.

There are varied demographic, economic, social and psychological factors determining the demand for a commodity like Sugar. Income, Sugar prices, substitutes and complements of sugar changes in consumer's taste and urbanization are some of the important factors that influence sugar demand. As consequence of Green Revolution and various other rural developments programmes, per capital income has gone up and changes in the consumption habits rural areas has created a powerful component of new demand for sugar in the country. With a shift of the population towards urban areas and an increase in the average income of the people as a result of industrialisation, the impact of income on rural demand for sugar is likely to be strengthened by a sharp rise in its demand in urban centers.

As regards consumption, the internal consumption rate in our country has been increasing steadily statewise and India as a whole. This fact will be borne out by the Table 4.2

4.3 Per Capita Consumption of Sugar In some Important Countries:

However, it is to be noted that level of Sugar Consumption at the rate of 22.1 Kgs per Capital per annum is very low as compared to foreign Countries Sugar consumption. The Consumption of Sugar and Sweets 141 grams per Capital per day in Australia. 140 grams in U.S.A. 136 grams in Britain and Canada each but only 65.2 grams in India. The table 4.3, shows that the consumption of Sugar in India is very low as compare to other countries of the world. Thus in accordance with dietary need of the country men, the per capita consumption would have to be increased backed with increasing rate of sugar production in order to strike a fine balance between consumption and production of sugar.

The consumption of Sugar is likely to grow at a faster pace due to improvement in living standards, change in dietary habits, increase in purchasing power etc. This is in keeping with the trends actually witnessed during the sixth plan period. The overall per capital consumption of total sweetening agents including gur and khandsari works out to about 23 kg. during the seventh plan period as against about 21 kg

Table 4.2

Per Capita Consumption of Sugar, Gur and Khandsari in India

Sugar Season (1)	Popula- tion in Million (2)	Consump- tion (Lakh tonnes) (3)	Per capita consumption (Kilogrammes per annum)		Total Consume- tion(Kgs) per annum (7)	
			Sugar (4)	Gur & Khand- sari (5)		
1950-51	362	10.98	34.29	3.0	9.5	12.5
1951-52	367	11.82	33.63	3.2	9.2	12.4
1952-53	373	16.79	27.72	4.5	7.4	11.9
1953-54	379	18.36	26.13	4.8	6.9	11.7
1954-55	385	17.51	31.03	4.5	8.1	12.6
1955-56	398	19.72	30.29	5.0	7.7	12.7
1956-57	400	20.18	51.00	5.0	12.7	17.7
1957-58	410	20.75	53.00	5.1	12.9	18.0
1958-59	420	21.13	56.71	5.0	13.5	18.5
1959-60	428	20.53	56.21	4.8	13.1	17.9
1960-61	439	21.27	66.87	4.8	15.2	20.0
1961-62	448	25.88	64.32	5.8	14.4	20.2
1962-63	458	24.86	60.74	5.4	13.3	18.7
1963-64	468	23.07	66.67	4.9	14.2	19.1
1964-65	478	24.69	72.05	5.2	15.1	20.3
1965-66	489	28.10	69.11	5.7	14.1	19.8
1966-67	500	26.01	61.25	5.2	12.2	17.4
1967-68	511	22.10	63.05	4.3	12.3	16.6
1968-69	523	26.09	73.46	5.0	14.0	19.9
1969-70	534	32.69	74.01	6.1	13.9	20.0
1970-71	546	40.27	74.73	7.4	13.6	21.0
1971-72	558	37.90	69.98	6.8	12.5	19.3
1972-73	570	35.13	70.30	6.2	12.3	18.5
1973-74	581	35.22	83.36	6.1	14.3	20.4
1974-75	593	35.14	80.63	5.9	13.6	19.5
1975-76	609	37.56	83.67	6.1	13.7	19.8
1976-77	621	36.87	88.41	6.0	14.2	20.2
1977-78	633	44.90	90.88	7.1	14.4	21.5
1978-79	646	62.09	75.96	9.6	11.8	21.4
1979-80	669	52.32	75.48	7.8	13.3	21.1
1980-81	685	49.70	86.33	7.3	12.6	19.9
1981-82	700	57.43	76.11	8.1	10.9	19.0
1982-83	710	60.88	85.54	9.0	12.1	21.1
1983-84	723	75.55	94.11	10.4	11.3	21.7
1984-85	737	80.93	89.82	11.0	12.2	23.2
1985-86	751	82.72	82.88	11.0	11.0	22.0
1986-87	765	86.87	82.00	11.4	10.7	22.1
1987-88	780	93.89	79.30	12.0	10.2	22.2

Source: Indian Sugar Year Book (1987-88) p. 154

Table 4.3

Per capita Consumption of Sugar in Some Important Countries

S.No	Countries	Sugar Consumption Kgs/annum
(1)	(2)	(3)
1.	Austria	47.1
2.	German Dem. Rep.	44.9
3.	Switzerland	43.1
4.	USSR	47.6
5.	Yugoslavia	44.9
Europe Average		41.9
6.	Canada	43.0
7.	U.S.A.	29.3
North America		30.6
8.	Cuba	66.0
9.	Costa Rica	60.7
10.	Mexico	43.4
11.	Panama	38.0
Central America		43.8
12.	Brazil	47.6
13.	Colombia	38.9
14.	Peru	36.3
15.	Venezuela	43.8
South America		41.6
16.	Japan	22.5
17.	Iran	28.7
18.	Iraq	36.1
19.	Pakistan	17.5
20.	India	11.4*
Asia Average		11.0
World Average		20.4

Source: Indian Sugar Year Book, Vol. I, 1987-88

* This refers to the white sugar produced in VPS. mills. Even we add sugar equivalent produced from khandsari sugar this comes to 22.1 kgs.

for the Sixth Plan Period. The demand of Sugar in the country reached 82 lakh tonnes in 1984-85 though production of sugar in the season hovered around 60 lakh tonnes resulting in large scale imports of sugar. The price of sugar group increased by 13.3 per cent in 1984-85 and by another 12.4 percent in 1985-86 (up to January 1986)².

The table 4.1 and 4.2 reveals that both production and the consumption surpassed the estimate of production and consumption of the sixth plan which says, "Domestic Demand for sugar would reach the level of 6-8 million tonnes by 1984-85. Given the potentiality of raising sugar cane output, it should be possible to raise sugar production from 3.9 million tonnes in 1979-80 to 7.6 million tonnes by (1984-85)³.

4.4 Cyclical Trends in Sugar Production:

As far as trends in Sugar production is concern, it has not been even over a period. The wide fluctuations in output were due to reduced yield of cane as a result of unfavorable weather conditions, draught and other factors (Table 4.2). As long as the major portion of output was from Utter Pradesh, where there was competition for available supplies from Gur and Khandsari producers these fluctuations are in wide

2. The Economic Survey, Government of India, 1985-86, Ministry of Finance, Delhi, pp. 52-53.

3. The Economic Times, dated 17-7-85.

limits. After Maharashtra and Southern states became important producers with an extension of cane cultivation, these fluctuations have been moderated. But the cane growers have lately been more responsive to the price paid for their supplies by sugar mills and the return available from competitive crops. If there were arrears of payments against cane supplies to the industry, the bulk of the crop was directed to the unorganised sector over the years, the increase in sugar production is more than in proportion to the increase in cane output over a basic level. It can also be seen that the demand for Gur and Khandsari has remain even with a growth in consumption of refined mill sugar (Table 4.2)

The all time record of 1981-82 in respect of sugar output, was facilitated by a good cane crop of 186.35 million tonnes. Also the manufacturers of Gur and Khandsari require a minimum of 80 million tonnes of cane and there was keen competition for securing this quantum when ever there was a decline in the yield of the crop due to drought or other factors. As there had also been a growth in consumption gur and larger use of the cane for conversion in to khandsari, the sugar mills, can be assured of their supplies, only if the yield of the crop increases by the least 6 million tonnes yearly, over a base of 180 million tonnes.

Thus central and state Governments have to thus ensure that the aggregate return on the cane crop is more alternative than that on other competing crops, and sugar mills too are able to make payments to the growers at rate which are also competitive as compared to their counterparts in the decentralised sector. Since Sugar Production has to be raised steadily in the coming decades for meeting a growing demand, the vagaries of the dual pricing system have to be avoided and the average price realized by the sugar mills on the output should be such as to ensure reasonable profitability for them after making available remunerative prices to have cane growers . The interests of consumers will also have to be safeguarded as there are wide changes in prices in the open market with wide changes in production.

4.5 The Changing Pattern of Demand:

The growth in Demand in the domestic market did not pose any problem until the 80's as the output was in excess of internal off take, excepting the years when there was a sharp decline in production due to the drought or other factors. No rational explanation is available about slow growth in consumption in earlier years, even though, sugar was distributed on controlled basis for most of the time. Perhaps, this was also a contributory factor because of inadequate availability in rural areas. The off take increased

to 37.57 lakh tones in 1976-77 from 11 lakh tonnes in 1950-51 but there was a spurt to 44.90 lakh tones in 1977-78 following decontrol in August 1978. With cheaper and free supplies, demand increased sharply to 62.09 lakh tonnes in 1978-79. There was a dip in the subsequent two years to 49.70 lakh tones in 1980-81.

(Table 4.4)

After 1980-81, however, there has been no looking back and the despatches from factories in 1985-86 were at an all time high 83.00 lakh tones, while marginal imports were made in earlier years to overcome small shortage it was only in 1984-86, that it became necessary to import on a large scale to meet internal needs, because of a drop in production, even after utilising about 30 lakh tonnes of the massive stock of 45.87 lakh tonnes at the end of 1982-83. The development during 1981-88 suggest that the consumption of refined Sugar will be rising steadily even with a concurrent growth in off take of Gur and Khandsari. Thus may even be a slower rise in the intake of Gur through the consumption from Khandsari producers may remain keen, if the organised sector is not able to secure its cane requirements at price which will satisfy the growers and which can also be afforded by it. The dependence on imports, because of rising demand, can be avoided only if the earlier fluctuations in output do not recur.

Table 4.4
Consumption, Export, Import and Availability of Sugar in India

(Figure in lakh Tonnes)

Season	<u>Off take for</u>		Import	Availabi- lity	Opening stock		
	Internal Consumption	Export					
(1)	(2)	(3)	(4)	(5)	(6)		
1960-61	21.27	3.03	-	36.33	6.05		
1965-66	28.10	4.30	-	42.04	6.72		
1970-71	40.27	3.90	-	58.24	20.84		
1974-75	35.14	9.41	-	56.23	8.28		
1975-76	36.87	9.50	-	54.69	12.07		
1976-77	37.56	3.41	-	56.72	8.32		
1977-78	44.90	2.53	-	80.32	15.75		
1978-79	62.09	8.36	-	91.31	32.89		
1979-80	52.32	2.30	1.63	61.07	20.89		
1980-81	49.70	0.60	1.53	59.45	6.45		
1981-82	57.43	4.15	0.77	94.28	9.15		
1982-83	64.88	4.25	-	115.00	32.70		
1983-84	75.55	6.59	0.94	105.98	45.87		
1984-85	80.93	0.32	11.87	97.04	23.74		
1985-86	82.72	0.36	16.19	102.14	15.79		
1986-87	86.87	0.22	9.53	113.60	19.06		
1987-88	93.89	0.18	9.71	118.34	26.53		
1988-89	99.36	0.18	-	111.83	24.31		

Source: Indian sugar year book (1987-88 & 1989-90)

It is pertinent to point out here that there was not net dependence on imports in earlier years. In fact, exports have had to be compulsorily effected to avoid an accumulation of stock. These were as high as 9.5 lakh tonnes in 1975-76, and during the period of world boom in Sugar Prices during 1974-76 foreign exchange earnings of as much as Rs.800 crores could be secured through sugar exports. In other years, the shipments ranged between 1.0 to 6.5 lakh tones, while imports were only 3.16 lakh tonnes during 1973-81, when production was affected by draught (Table 4.4.)

4.6 Trend of Sugar Production And Consumption in U.P.

As far as Sugar Production and sugar consumption is in Utter Pradesh concerned, it is to note that state is playing most important and vital role in sugar production, which is more than that of 25% of the total produce of the country but the sugar consumption in the state is less than half of the total sugar produced every year since 1976-77 to 1989-90 except in two years 1979-80 and 1984-85 (Graph IV) due to the unfavorable seasons for the sugarcane and low supply to the sugar mills. On the other side more than 50% of the produce of the state is utilised in other parts of the country i.e. inter state export of sugar takes place from Uttar Pradesh. (Table 4.5 and Graph V).

GRAPH IV
Production and Consumption of Sugar In Uttar Pradesh

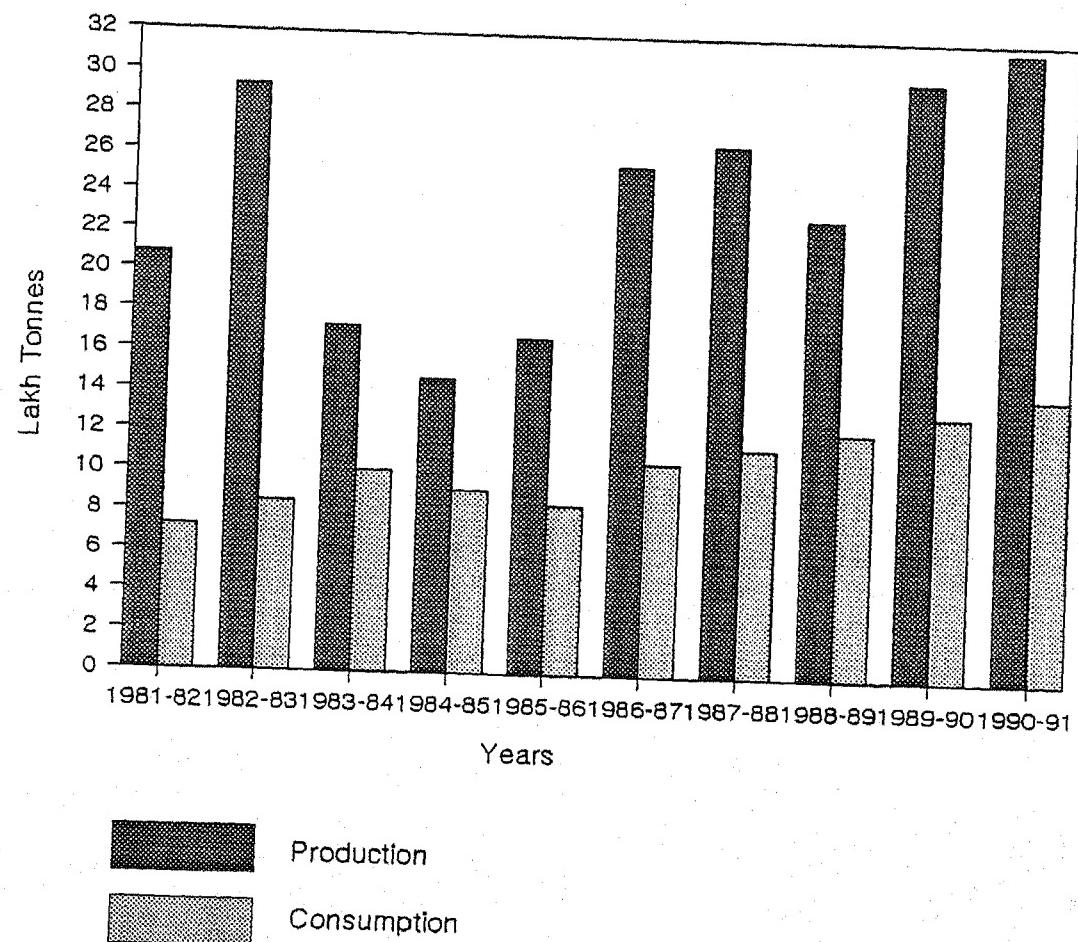


Table 4.5
Production and Consumption of Sugar in Uttar Pradesh

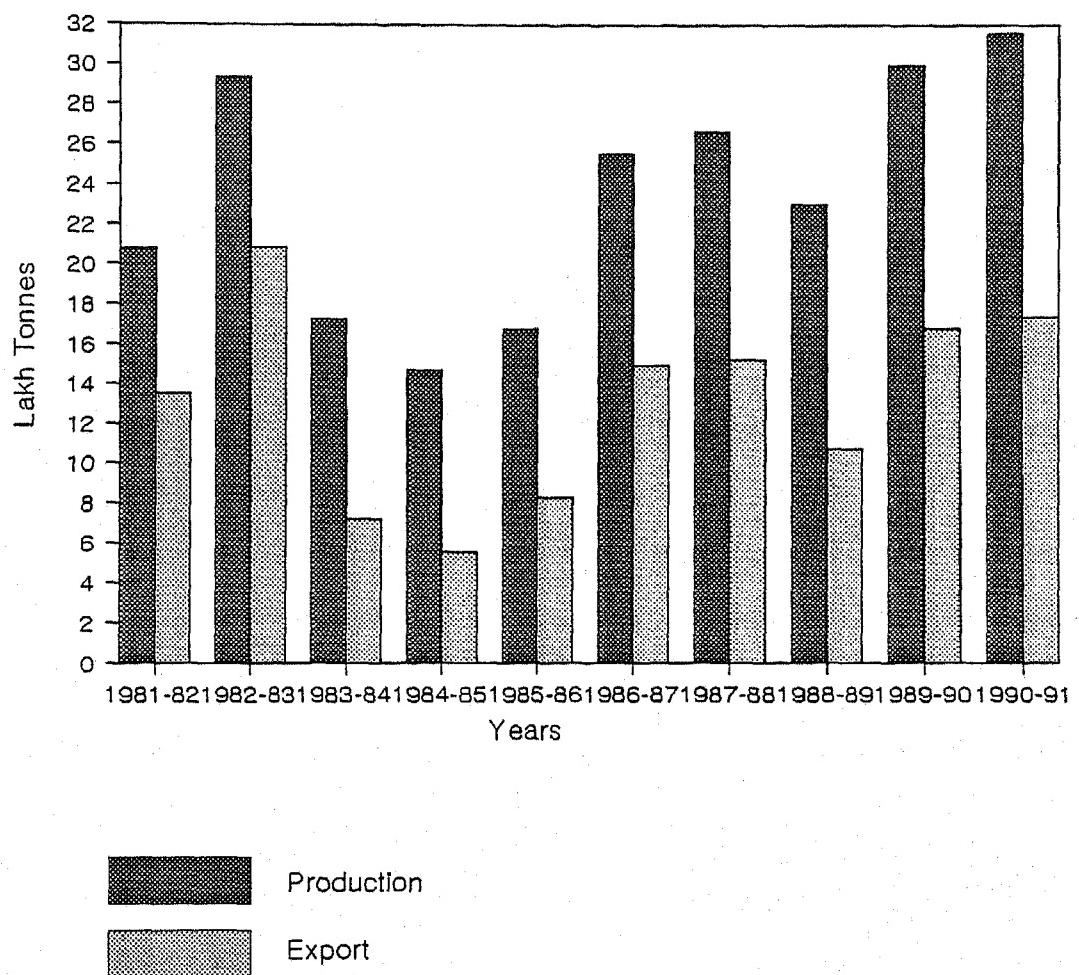
S.No	Year	Sugar Production (lakh tonne)	Sugar Consumption (lakh tonne)	Consumption outside the state (2-3) or surplus (lakh tonne)
	(1)	(2)	(3)	(4)
1.	1976-77	14.71	4.54	10.17
2.	1977-78	18.62	3.81	14.81
3.	1978-79	14.63	8.49	6.14
4.	1979-80	9.76	9.74	0.02
5.	1980-81	12.24	6.36	5.88
6.	1981-82	20.80	7.27	13.53
7.	1982-83	29.35	8.52	20.83
8.	1983-84	17.27	10.08	7.19
9.	1984-85	14.70	9.15	5.55
10.	1985-86	16.80	8.50	8.30
11.	1986-87	25.56	10.62	14.94
12.	1987-88	26.66	11.42(P)	15.24
13.	1988-89	23.02	12.29(P)	10.73
14.	1989-90	30.00	13.22(P)	16.78
15.	1990-91	31.59(P)	14.22(P)	17.37

(P) Projected

Source: Sugar production: Cane Commissioner's office, Lucknow.

Sugar Consumption: Indian Sugar Year Book (1987-88) p. 152.

GRAPH V
Production and Export of Sugar from Uttar Pradesh to other States



4.7 Forecasts about the Industry with Long - Term Perspective and Strategy:

The estimation of Demand for sugar and sugar production capacity and related factors with this industry like future per capita annual requirement for the consumption of sugar, total sugar production etc are desirable not only from the point of view of academic interest but also for the policy implications. Although, their use in predicting the future may hardly be dependable but as a measure of performance during a period they have considerable significance to policy makers.

The following formulas and tools are used, for forecasting India's population and other factors described above.

1. The compound Growth rates have been computed by the following formula :

$$r = \left[\text{AntiLog} \left(\frac{\sum \log P_t - \sum \log P_0}{\sum t} \right) - 1 \right] \times 100$$

where:

$$\sum \log P_t = \log X_1 + \log X_2 + \log X_n$$

$$\sum \log P_0 = n \times \log X_1$$

$$\sum t = n(n-1)/2$$

r = Compound Growth Rate.

or

Growth rate = @Rate(end value, initial value, no. of years)*100

As already been mentioned that the consumption of sugar is likely to grow at a faster pace, is clear

when per capital requirement of sugar is projected upto a period of 2001 to 2002 A.D. from 1989-90.

Table: 4.6 : Shows that the internal per capital consumption of Sugar in our country will increase steadily as compare to Gur and Khandsari, which will remain almost unchange. This is happening due to the change in consumers taste and other factors like increase in income and urban effect on rural areas. This is true that the quality of mill sugar is better than that of khandsari sugar, in taste due to the better and automatic technology used in mills but hardly difference in size and color of crystals. The requirement per capital sugar will be more than 17 kgs per annum in 2000-2001 A.D. as at present the consumption of sugar is 13 kgs. per capital per annum. The total requirement of sweetening agents like sugar, Gur and Khandsari per capita will be over 28 kgs in 2000-2001 A.D., as it is 23 kgs per annum now a days.

As far as my estimates are concerned the trends of sugar production and sugar consumption will follows as the data shows in Table 4.7. Thus this table is indicative of the fact that there will remain a gap between production and consumption of sugar in the country almost every year beginning from 1990-91 to 2000-2001 A.D., necessitating some far - reaching intensive measures on the part of the central and state Governments and the sugar complex to bridge the gap.

Table 4.6

**Projected Per Capita requirement of Sugar, Gur and Khandsari in India
(1990-91 to 2001-2002 A.D.)**

S.No	Year	Per capita Estimated Demand (Kgs. per annum)		
		Sugar	Gur & Khandsari	Sugar + Gur & Khandsari (2 + 3)
(1)	(2)	(3)	(2 + 3)	
1.	1990-91	13.02	10.37	23.39
2.	1991-92	13.38	10.43	23.81
3.	1992-93	13.75	10.49	24.24
4.	1993-94	14.13	10.55	24.68
5.	1994-95	14.53	10.61	25.14
6.	1995-96	14.93	10.67	25.60
7.	1996-97	15.34	10.73	26.07
8.	1997-98	15.35	10.79	26.56
9.	1998-99	16.21	10.85	27.06
10.	1999-2000	16.66	10.91	27.57
11.	2000-2001	17.12	10.97	28.09
12.	2001-2002	17.59	11.03	28.62

Table 4.7

**Projection for Sugar Production and Sugar Consumption in India
(1990-91 to 2001-2002 A.D.)**

S.No	Year	Sugar Production (Lakh Tonnes)		Sugar Consumption (Lakh Tonnes)
		(1)	(2)	(3)
1.	1990-91		104.83	108.60
2.	1991-92		109.85	114.01
3.	1992-93		115.12	119.68
4.	1993-94		120.63	125.63
5.	1994-95		126.42	131.88
6.	1995-96		132.47	138.44
7.	1996-97		138.82	145.33
8.	1997-98		145.47	152.55
9.	1998-99		152.45	160.14
10.	1999-2000		159.75	168.11
11.	2000-2001		167.41	176.47
12.	2001-2002		175.43	185.25

4.8 Forecast about Demand for Sugar and Sugar Production Capacity:

The new trend in consumption noticed in recent years and the desirability of eliminating foreign exchange expenditure on imports, when refined sugar can be produced in the required volume, emphasis the importance of rising production by yearly average of 6% to 7 % at least over a period. The demand for sugar may increase to 138.44 Lakh tonnes in the year 1995-96 and will be 176.47 lakh tonnes in 2000-2001 A.D., according to my estimations, keeping in view the rise in population, the growth in the GDP, the demand elasticity for sugar and consumers taste it is projected by 2001-2002 A.D., The total requirement of sugar for domestic consumption will be of the order of 185 lakh tonnes, and if export requirement of 10 to 15 lakh tonnes is considered it would become 200 lakh tonnes in 20001-2002 A.D. The demand in Uttar Pradesh also will jump from 14.22 lakh tonnes in 1990-91 to 31.80 lakh tones in 2001-2002 A.D. (Table 4.8) Thus it would be necessary to increase the production capacity of white sugar from the present level.

As the installed sugar production capacity of the industry was only 88.26 lakh tonnes in 1989-90, the industry will have to be developed systematically in the private, co-operative and in the public sectors. For securing quick results, high priority may have to be accorded to the implementation of the expension schemes of the efficient units in Maharashtra, Andhra

Table 4.8

**Projection for Demand and Installed
Annual Sugar Production Capacity in India and U.P.**

S.No.	Year	Projected Estimation of Population (All India) (In Million)	Projected Estimation of Demand of Sugar (All India) (Lakh tonne)	Projected Estimation of Demand of Sugar (U.P.) (Lakh tonne)	Projected Estimation of Sugar Production Capacity (All India) (Lakh tonne)	Projected Estimation of Sugar Production Capacity (U.P.) (Lakh tonne)
(1)	(2)	(3)	(4)	(5)	(6)	(7)
1.	1990-91	831.87	108.60	14.22	92.02	21.10
2.	1991-92	849.92	114.01	15.30	95.93	21.74
3.	1992-93	868.35	119.68	16.46	100.02	22.41
4.	1993-94	887.19	125.63	17.71	104.27	23.09
5.	1994-95	906.44	131.88	19.06	108.71	23.79
6.	1995-96	926.10	138.44	20.51	113.33	24.52
7.	1996-97	946.20	145.33	22.06	118.16	25.26
8.	1997-98	966.72	152.55	23.74	123.19	26.03
9.	1998-99	987.70	160.14	25.54	128.43	26.82
10.	1999-2000	1009.12	168.11	27.47	133.89	27.64
11.	2000-2001	1031.02	176.47	29.56	139.59	28.48
12.	2001-2002	1053.38	185.25	31.80	145.53	29.35

Pradesh, Karnataka and Tamil Nadu, while improving the efficiency of the older units in the Utter pradesh with a certain of additional capacity though modernisation expansion and new schemes.

4.9 Re-Assessment of Capacity:

The committee constituted to formulate, Development programme during the 8th Five Years Plan period was also entrusted with the task of re-assessment of installed capacity in the industry. The group recommended reassessment of capacity based on average duration and recovery during the last 10 years 1970-79 to 1987-88 . The group further recommended that the weighted average duration should be taken in to account in computing the average duration days in each region as against the simple average duration adopted so far. On the above basis, the installed capacity which was assessed at 85.03 has been re-assessed at 91 lakh tonnes.

4.10 Recommendation -For 8th Five Year Plan:

The committee constituted to formulate the Development programme for sugar for the 8th Five Year Plan period (1990-95) submitted its recommendations to the Government. The salient features are as follows. On the basis of consumption growth rate of 5% per annum it has projected the requirement in 1994-95 at 134.13 lakh tones and that of the installed capacity

at 141.19 and the licensed capacity at 180.27 lakh tonnes. The committee recommended that the radial distance of 40 Kms. be maintained between the existing units and the proposed units during the 8th Five Year Plan period. The relaxation in the spatial distance norm from 40 Kms. to 25 Km. be subject to the modified condition that per hectare yield is more than 30% of the National average and to the satisfaction of the Department of Food.

The Sugar mills with minimum initial capacity of 2500 TCD be established. In the case of areas which are declared industrially backward by the Central Government/State Governments and which are agro-climatically suitable for sugar cane cultivation new capacity may be reduced to 1750 TCD..

As far as my own estimates are concerned it shows that the requirement for the sugar in the future will increase very fast and will be necessary to increase the installed sugar capacity simultaneously. As the installed sugar production capacity of the Industry was only 84.66 lakh tonnes in 1988-89 and it was 19.87 lakh tonnes in Utter Pradesh in the same year can increase only at 4.25% compound Growth rate, which is lower in Uttar Pradesh - is 3.04% Growth rate. Installed sugar production capacity will be 108.71 lakh tonnes in 1994-95 and 139.59 lakh tonnes in 2000-2001 A.D. in India and will be 23.79 lakh tonnes in

1994-95 and 28.48 lakh tonnes in 2000-2001 A.D. in Utter Pradesh. Table 4.8.

4.11 Need for Modernisation, Rehabilitation And Optimisation:

The objectives of the sugar policy should be thus, the promotion of cultivation of Sugar Cane, development of additional capacity and measures for improving recovery and reducing costs. In view of advancing technology and the importance of costs, the sugar mills have to be modernised and also helped to operate with optimal capacity. In the earlier years, many units with capacity of 400-800 tonnes daily (tcd) were established, particularly in Uttar Pradesh. There location was also not scientifically conceived and difficulties arose with regard cane supply. The profitability of the industry has not been satisfactory and heavy losses have been sustained by many units because of the unimaginative controls over prices and distribution.

The older units become sick. A study conducted by the Institutional Finance committee for Sugar industry (Reserve Bank of India) has revealed that 67 per cent of the units in this industry are sick. Within the last decade, the Government has taken over 44 sugar factories. The soft loan scheme of the Industrial Development Bank of India for modernisation could not make much head way because of the inadequate profitability of the industry. The sugar mills

promoted after the 60s had a crushing capacity of 1250 tonnes daily (TCD). Those located in the southern region have a longer crushing season and are also operating more efficiently. The enterprising managements paying serious attention to cane development in areas adjoining their factories have raised the crushing capacity to even 5,000 tonnes daily. Under the new policy formulated by the Government it is considered that the optimum capacity is 2500 tonnes per day and that the existing units should be allowed to raise their capacity to this level, where the required additional quantities of cane can be assured. The capacity can be raised advantageously to 4000 -5000 tones daily (TCD), scope for the mills concerned to have extended cane cultivation.

As it will be necessary to create additional capacity in a big way, even with intensive use of existing facilities and a longer crushing season new Sugar mills with a minimum capacity of 2500 tonnes daily (TCD) will be coming up. The preference for the grant of licenses will be for sugar mills in the co-operative, public and private sectors in that order. As an entirely new sugar mill with a capacity of 2500 tonnes daily will require an outlay of Rs.18 crores on the basis of 1986 prices and the output of sugar has to be raised by 135 lakh tonnes by 1995 -96, with an additional capacity for 50 lakh tonnes of sugar has to

be created. Even assuming the 50 percent of new capacity can be created by modernisation and expansion, the remaining 50 percent of capacity will require the promotion of 35 entirely new sugar mills. To raise the installed capacity the Government has allowed 57 Sugar factories to expand their capacities and has issued 19 letters of intent for the setting up of new units.

As the average outlay will increase in a decade, the new mill may require an investment of Rs.650 crores. As the expension and modernisation schemes will be much cheaper, the out lay in this may be around Rs.500 crores. The Industry will thus have to invest as much as Rs.1200 crores during 1986-96. As it has had a checkered carear in the recent past, its economies of operation has to be considerably improved, the return on capital employed will have to be a minimum of 14 percent even after taxation. As the dual pricing policy was being continued in the Seventh Plan and some measures of control would always be exercised by the central and state Governments, the policies will have to be suitably changed for ensuring reasonable profitability of this major Industry, so that it can come up from great losses.

The demand for Sugar may well rise over 180 lakh tones by the turn of the century. So unlike in previous years, the Industry has to raise it output steadily for meeting the growing demand for refined

sugar. Also, the policy regarding fixation of minimum price for cane has to be pragmatic, while the entire cost of cane should be taken in to account, when computing the retention price. The Policy of State Governments working independently of the center, requesting sugar mills to make payments to growers at price higher than the statutory minimum and which were not taken into consideration for determining costs would have to be discontinued.

Apart from the need to secure a satisfactory return on net worth, the Industry should be enabled to modernise its facilities, for minimising sugar losses, saving energy consumption and improving recovery of Sugar Consumption and improving recovery of Sugar. The resources required for modernisation should be made available in great measures, in the form of soft loans, While every encouragements should be given for raising crushing capacity initially to 1250 tonnes daily (TCD) particularly in Uttar Pradesh. Where many mills have uneconomic capacities and subsequently to 2500 tonnes daily (TCD). This was considered to be an optimum size in the mid 80s. The Government has actually permitted the existing mills to raise their capacities to this level where it was possible for them to obtain the required sugarcane supplies and tend also to the area under the cane crop wherever feasible. The prospects for the industry are assured and needed fund for implementing modernisation,

expansion and new schemes could be found with well conceived fiscal and price policies.

The causes of the current crisis in Sugars are rapid increase in the demand and instability in the production of Sugar Cane. The share of India in world sugarcane production is about 25%. India produces more sugarcane than Brazil and Cuba taken together thoughts contribution to the world cane sugar production exclusive of non-centrifugal sweeteners (Gur and Khandsari) is hardly 10%. Thus these seems to be considerable scope for exploiting our sugarcane potential to the best advantages of the country. These are indeed redeeming features of the sugar Industry.

Thus, the current all India Sugar scenario is anything but bright. Afforts must be done to make a bridge between production and consumption also to control the sugar price Viz-a-Viz to see a genuine profit of sugar industry and cane growers and try to avoid the situation as the consumers are freed to pay higher prices while the sugar Industry is reeling under heavy losses-besides, the farmers are not paid for sugar crops for months and some times for years.

CHAPTER 5

CAPITAL AND LABOUR INTENSITIES

In general, different indicators can be used to measure Capital and labour intensities, be it in manufacturing or Construction. A decision regarding with indicator in most appropriate is therefore needed, before we start examining labour intensity of individual projects and at the level of industry as a whole. A part from usual difficulty of finding Capital data, the ratio of capital to labour (K/L) which is used as a measure of capital intensity (and its inverse, that of labour intensity,) leaves out actual efficiency considerations which are better examined through input output coefficients, e.g. labour output ratios, Capital output ratios or the share of wages in value added. For example at any level of aggregation a production function does not describe what output will be achieved for given levels of different inputs: rather a production function describes the maximum level of output that can be achieved if the inputs are efficiently employed¹.

Most of the studies tend to consider only the final stage of production and the techniques used at

1. Franklin M. Fisher : The existence of aggregateproduction function", In *econometrica* (New Haven, Conn.) Vol. 37, No.4, Oct. 1969.

that stage. Intermediate stages and different process of production at each stage generally are ignored. Labour-intensive final products would require that intermediate inputs to the manufacture of these products should also be more labour intensive than capital intensive final products. In practice, if one stage of production has higher technical requirements for labour input per unit of output or capital, the aggregate labour intensity would be higher than otherwise.

Before looking into the capital intensities and labour intensities, or to calculate capital output ratio and labour output ratio, in the two techniques of producing crystalline sugar, i.e. modern sugar mills (VPS) and improved khandsari units (OPS), it is necessary to know about the forms of capital, which required for the VPS and OPS plants. Also it is important to know about, how many types of workers and other staff are needed in these two types of establishments.

The establishment of a large and modern factory generally need a huge amount of capital. Firstly, it is needed for the purchase of land, site development, provision of infra structural facilities such as construction of approach roads etc. Secondly, buildings for the factory, godowns, work-shops, administrative officers, residence of employees' and Guest houses, etc. have to be constructed. Thirdly,

plants and machinery have to be purchased for the factory, then furniture, electrical installations, water supply, vehicles etc. are provided. Fourthly, the provision has to be made for contingencies, stores and spares, margin money for purchase of raw materials, payment of wage and salaries etc.

The National Planning Committee in their report submitted in 1949, had said: "the financing of industries as commonly understood involves providing fixed and working capital needed for equipment, including machinery tools, plant and implements, buildings, stores, raw materials and wages for labour, cost of fuel and power etc. which are necessary to set up an industry and to work in its initial stages, until the product is marketed and the proceeds begin to pay for the expenses of production"². Capital required for these purposes can be broadly classified as fixed capital and working capital.

5.1 Fixed Capital:

Fixed capital consists of lands, buildings, electric installations, machinery etc. The fixed or long term capital includes long time and large amount of loans which are required for the inception of the new industries and also included more or less the permanent funds which an old established concern need

2. Industrial Finance in Bihar, Bhar Institute of Economic Development, Patna, 1974, p.5.

to extend and re-organize itself, to remove old plants much of which may have become absolute and refit with the best appliances and lastly funds required for the prompt implements of new process and discoveries. The initial capital is generally and mainly raised by means of shares sold to the investing public and the capital for replacement and extension is usually raised by means of issue of debentures."³

5.2 Working Capital:

Capital for purchase of raw materials, payment of wages to workers, transport cost etc. are called working capital. "The floating or working capital is required to meet the current expenses on raw materials and stores, incidental to marketing products, and also to meet the out standing dues in respect of goods supplied and lastly for paying wages and other expenses of day-to-day requirements." These credits are of temporary or seasonal nature, either self liquidating or to be repaid ultimately out of the working of the factory. Working and Fixed capitals are compulsory for a mill. Sugar mills and Khandsari mills require both the fixed and the working capital.

As far as requirement of workers is concern in the two systems of producing sugar, sugar factory requires almost every category of workers such as unskilled, semi-skilled, skilled, Highly skilled,

3. Ibid, p.3.

supervisory staff, technical staff and administrative personnel etc. While khandsari mills require such workers as un-skilled, semi skilled and highly skilled, technical and administrative. Most of the job of administrative staff is mostly done by the owner of the unit.

Sugar and Khandsari industries in India are purely a seasonal industries. As far as sugar industry is concern, its season starts from the middle of november and generally lasts up to May or June. Hence the nature of employment in this industry is both seasonal and non-seasonal. It is perhaps the only important organised industry in India where seasonally employed workers pre-dominate. The seasonal workers are those who work in the factory so long the factory is in operation and sugarcane crushing is continuing. The workers are also employed on a permanent basis but as the volume of work in a sugar factory is not enough to give them work throughout the year, they leave the factory, go back to their houses in the off season and report back to work when the factory begins crushing in the next season. They do not get full salary and allowances for the off months but they are given a certain percentage of salary and allowances in off-season and on rejoining in next season. They get the full salary for the period when the factories are in operation. In some of the states such as Uttar Pradesh, Bihar,

Assam, Madhya Pradesh and Rajasthan, about three-fourth or even more employees are seasonal. Generally, the southern states such as Tamilnadu, Orissa, Maharashtra etc. have larger proportion of non-seasonal workers.

Besides seasonal workers, there are casual and purely temporary workers employed in the sugar industry. The non seasonal permanent workers are those who are employed on a permanent basis and who have to work in the factory throughout the year. Nature of employment of such workers is not permanent and they are employed whenever the work-load increases and are discharged when it lessens. Besides, there are supervisors, administrative staff etc. who are permanent and work all the year round.

The percentage of unskilled workers are generally more in the traditional sugar producing areas than that of the new areas. For example, in Uttar pradesh, Madhya Pradesh, Bihar, Rajasthan, more than half of the employees in sugar factories are unskilled. Where as in Gujarat, Orissa, Kerala etc. the proportion of unskilled is about one-third of the total workers employed in the industry.

Sugar industry gets its raw materials from cultivators. So it has to keep a large number of supervisors, field staff etc. These members of the staff survey the areas under sugarcane, assess the quantity of sugarcane in fields, give demonstrations

involved new varieties of seeds, and issue permits for supply of sugarcane to factories on different dates etc. Moreover, many of the sugar factories have their own sugarcane farm for which they keep additional staff, both permanent and casual.

All the sugarcane that a factory gets do not get delivery at the factory gate by the farmers. It is generally supplied at out station collection centres. From these centres sugarcane has to be transported to the factories. On all these centres the sugar factories have to keep staff for weighment, for watching and protecting the sugarcane weighed from theft etc. Factories also keeps casual workers or contract workers, for loading weighed sugarcane in railway wagons or trucks.

Besides this, sugar industry creates indirect employment also. Molasses, bagasse, press-mud etc. are the by-products of sugar industry. Molasses are used for making, alcohol, feed for animals food yeast and edible syrup etc. Similarly, bagasse is used for manufacturing paper, energy etc. When by products become the raw materials for different industries, they become a sources of employment.

5.3 Classification of Labourers/Employees in Sugar Industry:

The designations by which the employees are known generally are as under:

Managers, chief chemist, chief Engineer, Assistant chemists, sugar Boiler, Head Penman, Apprentices, Mates or Jamadars, Liquor-man, centrifugers, Engine Drivers, Oilers, Turners, Fitters, Electricians, Firemen, Supervisors, Blacksmiths, cleaners, Repairers and coolies. The coolies work in various departments and are known by different names, such as wagon coolies, cane carrier coolies, Mill coolies, Liming Tank coolies, Juice Heater Coolies, Furnace Coolies, pan coolies, Press Fitter and Mud coolies, Hopper coolies and Dryer Coolies.

The employees in a sugar factory can be classified in to the following categories, viz., Operatores, Clerical, Supervisory, Technical/Professional, administrative, executive and others. Among the important sugar producing states, Uttar Pradesh employes the highest percentage of the unskilled workers (57.5), where as in Gujarat unskilled workers account for only 34.3 per cent of the workforce. It is evident from Table 5.1 that as far as the highly-skilled category is concerned, Tamil Nadu was leading with 2.7 percent, followed by Andhra Pradesh with 2.3 percent, Maharashtra with 1.7 percent, Uttar Pradesh with 1.6 percent Karnataka with 1.5 percent and Bihar with 1.0 per cent. Table 5.1 presents the position and nature of classification of workers on the basis of skill and tenure in sugar industry.

As regards seasonal employment according to Second central Wage Board Report Madhya Pradesh had highest percentage (79.4) followed by Assam with 78.2 per cent (Table 5.2). In this respect Rajasthan stands third with 76.6%, Bihar had 75.4%, West Bengal

Table 5.1

**Statewise Percentage Composition of Employees in
Different Categories in Sugar Industry**

Staff	Unskilled	Semi-skilled	Skilled	Highly Skilled	Clerks	Supervisory	Technical & professional	Administrative & Executive	Others
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Andhra Pradesh	44.3	18.9	12.1	2.3	13.4	1.9	0.9	0.4	5.4
Assam	61.4	14.9	4.8	2.8	15.0	0.9	-	0.2	-
Bihar	59.5	16.6	7.0	1.0	11.3	0.9	0.4	0.4	2.5
Gujarat	34.3	14.9	8.6	3.2	22.8	1.8	0.4	0.2	13.7
Kerala	36.8	19.9	12.1	2.6	11.3	1.8	1.0	3.0	11.8
Madhya Pradesh	63.0	14.8	8.5	1.3	9.5	0.8	0.4	0.2	1.5
Maharashtra	46.2	21.0	12.8	1.7	12.3	1.6	1.1	0.5	2.8
Karnataka	45.6	21.6	11.4	1.5	14.5	2.5	0.7	0.8	1.4
Orissa	36.7	26.8	16.4	1.9	14.1	-	2.7	1.3	0.1
Pondicherry	45.5	17.3	12.3	3.1	17.2	4.6	-	-	-
Punjab	48.7	21.7	8.7	1.9	14.6	1.4	0.6	0.4	2.0
Rajasthan	56.4	17.7	6.7	1.4	11.8	1.4	0.1	0.2	5.3
Uttar Pradesh	57.9	19.1	7.5	1.6	9.5	0.7	0.5	0.3	2.9
Tamil Nadu	46.7	16.9	12.5	2.7	14.3	1.9	1.2	0.8	2.7
West Bengal	51.6	21.6	7.6	1.6	16.0	1.1	0.4	0.1	0.6
All India	53.1	18.0	9.3	1.7	11.6	1.2	0.6	0.5	3.1

Source: Second Central Wage Board for Sugar Industry, 1970, Chapter III, p. 17.

Table 5.2

The Percentage Composition of Seasonal and Permanent Employees

State	Second Central Wage Board Report		Third Central Wage Board Report	
	Seasonal	Permanent	Seasonal	Permanent
(1)	(2)	(3)	(4)	(5)
Andhra Pradesh	55.3	44.7	47.5	52.4
Assam	78.2	21.8	50.6	49.4
Bihar	75.4	24.6	71.9	28.1
Gujarat	65.4	34.6	49.4	51.6
Kerala	55.4	44.6	64.3	35.7
Madhya Pradesh	79.4	20.6	67.8	32.2
Maharashtra	49.4	50.6	46.7	53.3
Karnataka	59.0	41.0	48.5	51.5
Orissa	47.7	52.3	61.3	38.7
Pondicherry	61.2	38.8	47.7	52.3
Punjab	65.6	34.4	57.5	42.5
Rajasthan	76.6	23.4	51.6	48.7
Tamil Nadu	45.3	54.7	47.6	52.4
Uttar Pradesh	71.4	28.6	63.0	37.0
West Bengal	74.7	25.3	-	-
All India	64.9	35.1	55.1	44.9

Source: 2nd and 3rd Central Wage Board for Sugar Industry Report 1970 & 1980.

74.7 per cent and Uttar Pradesh 71.4% whereas the corresponding figure of all India Employees is only 64.9%. Thus sugar factory employees face hardship due to this seasonal employment.

5.4 Change in the Composition of Seasonal and Permanent Employees:

A comparison of two Reports by Second Central Wage Board Report (1970), and (Third Central Wage Board Report (1980)) indicate that the number of seasonal employees in sugar factories had declined in almost in all the major sugar producing states and the share of permanent employees had increased almost in all the states, except in three states namely Kerala, Orissa and Tamil Nadu, where this trend had been reversed. (Table 5.2).

5.5 Average Number of Employees Per Factory in Sugar Industry:

Sugar industry in the country employs about 3.6 lakh persons including a sizeable number of technical staff of highly trained engineers and sugar technologists. The total wage bill including other benefits amounts to over Rs. 700 crores per year. The average number of employees per sugar factory is given in the following Table 5.3

Table 5.3

Average Number of Employees per Factory

State	1957-58	1965-66	1986-87
(1)	(2)	(3)	(4)
Andhra Pradesh	1093	946	713
Assam	--	924	753
Bihar	1134	1044	855
Gujarat	545	620	1001
Kerala	811	798	609
Madhya Pradesh	970	967	671
Maharashtra	840	871	931
Karnataka	1172	921	791
Orissa	594	473	475
Pondicherry	--	546	761
Punjab	1485	903	651
Rajasthan	1837	960	1168
Tamil Nadu	1031	907	810
Uttar Pradesh	1224	1203	978
West Bengal	1021	996	--
All India Average	1114	1002	878

Source: 1st, 2nd, 3rd Central Wage Board for Sugar Industry.

5.6 Supply of Labour and Methods of Recruitment in Sugar Industry:

The Labour Investigation Committee at the time of their enquiry had found that workers were generally recruited at the gate through the heads of the departments. The supervisory, technical or other supervisory staff were appointed by the General Manager in consultation with the managing agents or proprietors. According to a survey, an overwhelming majority of workers (about 96%) were found to have been recruited directly. Recruitment at the factory gate itself accounted for about 65 per cent. About 6 per cent had been recruited through labour offices. The remaining 4 per cent of the workers not directly recruited were highly skilled. But the production workers, technical and managerial personnel or clerical staff were found to be recruited through advertisement according to the Labour Investigation Committee.

The Labour Investigation Committee also made a report about the survey regarding the Apprenticeship in major sugar producing states. The survey has revealed that training and apprenticeship facilities have been provided in about 41 per cent of the sugar factories in the industry. The proportion of such factories was about 67 per cent in Southern India, about 53% in Bihar, nearly 42% in Maharashtra and

approximately 35% in Uttar Pradesh⁴. Apprentices were being mostly trained as turners, welders, moulders, boiler attendants, panmen, assistant chemist etc.⁵

As already been mentioned in Chapter one, that two sugar mill has been taken for the primary information and the two factories were Dhampur Sugar Mill Ltd. and Chandpur Sugar Mill Ltd. There is a very big difference in these two units in all aspects. Dhampur sugar mill is in private ltd. sugar mill, where as Chandpur sugar mill is State Government. Under taking mill is a low crushing capacity as compare to Dhampur mill. At the time of field survey it is found that there is also a big gap in Fixed capital, Working Capital, productive capital and also in Gross Value of output of sugar and total gross value of output including by-product. This is only because of the size difference and crushing capacity gap between these two units and also due to better management and other facilities in private sector. As Dhampur is a private and very big mill big not only in Northern India but also biggest sugar mill of the country. Table 5.4 shows the capital involved in these two sugar mills.

4. Report of the Second Central Wage Board, op.cit, p.11.

5. Report on Survey of Labour Conditions in Sugar Factories in India, 1962, Chapter 11, pp. 1718.

Table 5.4

**Fixed, Working, Productive Capital and Gross Value of Output
in two Sample Sugar Mills of Distt. Bijnor (1989-90)**

Units	Total Fixed Capital (Rs.)	Total Working Capital (Rs.)	Productive Capital (Rs.) (2 + 3)	Gross Value of Output of Sugar (Rs.)	Total Gross Value of Output including By-products (Rs.)
(1)	(2)	(3)	(4)	(5)	(6)
Dhampur Sugar Mill	516622411	185855851	702477992	890775757	904914736
Chandpur Sugar Mill	37705695	33284604	70990299	120631582	166255847
Total of Units	554328106	219140455	773468291	1011407339	1071170583

5.7 Employment in Two Sample VPS, Mills in Bijnor:

The employment breakup of workers, i.e. into regular and seasonal Male, female and child is given in Table 5.5 for these two sugar mills.

Table 5.5

**Employment Structure of two Sugar Mills of District Bijnor
(1989-90)**

Unit	Regular			Temporary			Total
	Male	Female	Child	Male	Female	Child	
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Dhampur Sugar Mill	450	2	-	750	-	-	1202
Chandpur Sugar Mill	400	12	-	350	-	-	762
Total of two Mills	850	14	-	1100	-	-	1964*

It is clear from table 5.5, that although in respect of total workers there is hardly any difference between Chandpur Sugar Mill and Dhampur

Sugar Mill, but there is big difference in the seasonal or temporary workers in these two sugar mills. There are 400 more temporary workers working in a season in Dhampur Sugar Mill as compared with Chandpur Sugar Mill.

Khandsari Units:

We have seen above, about the characteristics of the sugar mills, like Capital - (Fixed capital, Working Capital and productive capital) and employment - (Permanent and Seasonal) in general and in two sample sugar mills of District Bijnor. We now turn our attention towards capital and labour employed and on the expenditure pattern of the Khandsari units in general and ten units of District Bijnor covered by me during the field survey and information relates to the 1989-90 crushing season.

In Khandsari industry, the raw material is also sugarcane. "The industry comprises about six thousand small scale open Pan mini sugar plants. It is labour-intensive and located in rural remote areas"⁶. This industry is mainly located in Uttar Pradesh, Andhra Pradesh, Maharashtra, Madhya Pradesh, Gujarat and Karnataka. Khandsari industry crushes about 10 per cent of the sugarcane produced in the country. Apart from this, very large number of people are engaged in

6. Desh Pandey, V.V., "Role of Khandsari in Sugar Industry", The Economic Times, 28th November, 1985.

this industry. Khandsari industry require small capital as compare to big sugar mill and also this is suited to India's conditions. One thing that attracts attention is just as in the textile industry, where there are composite mills, powerlooms, Handloom sectors, in the sugarcane based industry there are large scale sugar mills and Khandsari Industry. Over and above "Sugarcane cultivation involves about 25 million farmers and another 0.275 million skilled and unskilled workers, including highly qualified and trained technologist are engaged in the manufacturing of sugar"⁷.

5.8 Land and Building for OPS Units:

A Khandsari unit needs sufficient land because it needs a lot of space to pile up sugarcane and also to spread the bagasse to let it dry. The bagasse is a major fuel input of these units. Therefore, it finds that a fair investment has been made in the land and buildings by the Khandsari units. In district Bijnor 40 per cent units fall in the size group of below Rs. 2.00 lakhs while rest 60 per cent in the size group of Rs. 2-3.00 lakhs. Out of these 60 per cent of units, two units cost 2.5 lakhs each those are newly constructed. Keeping in mind that most of these units are old and also the fact that land was procured in

7. Singh V.P. and Kairon M.S., "Constraints and Remedies", The Economic Times, dated 28.11.1985.

the remote rural areas, these values are fairly high. The average of land and building works out to be around Rs. 1.95 lakhs per unit in district Bijnor. These two units have an overall higher value of land and building. This is partly because these units have a higher crushing capacity. Another reason is that these two units were established during the 1980's by when the land and construction prices had gone up. Thus it finds that about 60 per cent units have a land and building value of over Rs. 2.00 lakhs and 40 per cent units have a value of below Rs. 2.00 lakhs. The average value of land and building in Bijnor district is only Rs. 1.95 lakhs (Table 5.6).

Table 5.6

Distribution of OPS Units by Size of Land and Building in Distt. Bijnor (1989-90)

Size Groups of Land and Building (Value in Lakh Rs.)	Number of Units
(1)	(2)
No Response	-
Below -- 2	4 (40.00)
2 -- 3	6 (60.00)
3 -- 4	-
Above -- 4	-
Total	10 (100.00)
Average Value (Rs.)	195535.50

Note: Figures in bracket indicate the percentage to column total.

5.9 Value of Plant and Machinery:

The figures of plant and machinery are (Book Value or depreciated value) and not the original purchase prices. The units of the district Bijnor are highly concentrated in the size group upto 3.00 lakhs (70 per cent) approximately. Only one unit that showed a value of plant and machinery of the size group 3.00 lakhs to 4.00 lakhs of rupees. The remaining two units have a value of plant and machinery works out to be Rs. 1.76 lakhs. The units are mainly found in the size group of Rs. 2-3 lakhs (70 per cent units). The average value of plant and machinery for the district Bijnor is Rs. 2.13 lakhs only (Table 5.7).

Table 5.7

Distribution of Units by Size of Plant and Machinery in Bijnor (1989-90)

Size Groups of Plant and Machinery (Value in Lakh Rs.)	Number of Units
(1)	(2)
Below -- 2	2 (20.00)
2 -- 3	7 (70.00)
3 -- 4	1 (10.00)
Above -- 4	-
Total	10 (100.00)
Average Value (Rs.)	213272.20

Note: Figures in bracket indicate the percentage to column total.

5.10 Total Fixed Capital of OPS Units:

The fixed capital is the combination of both value of land and building and value of plant and machinery. District Bijnor, its units are mainly concentrated in the medium higher groups as far as Fixed Capital is concerned. About 60 per cent units have a fixed capital size is below 6.00 lakhs rupees. While if we take the size group of Rs. 2-4 lakhs we get almost 30 per cent units. Another 10 per cent of the units comes a fixed capital group of below Rs. 2.00 lakhs. Its average value per unit, therefore, stands at Rs. 3.91 lakhs. (Table 5.8).

Table 5.8

**Distribution of Units by Value of Fixed Capital
in Bijnor (1989-90)**

Size Groups of Fixed Capital (Value in Lakh Rs.)	Number of Units
(1)	(2)
Below -- 2	1 (10.00)
2 -- 4	3 (30.00)
4 -- 6	6 (60.00)
Above -- 6	-
Total	10 (100.00)
Average Value (Rs.)	391337.70

Note: Figures in bracket indicate the percentage to column total.

5.11 Working Capital of OPS Units:

As already mentioned above, capital for purchase of raw materials, payment for wage to workers, transport cost etc. are called working capital or floating capital. Most of the units (60 per cent) in district Bijnor have a working capital of below Rs. 4.00 lakhs. The next important size group for the district is the highest size group of below Rs. 6.00 lakhs as it covers rest of the 40 per cent of the total units. Thus it finds a situation, where units are operating with a sizeable amount of working capital. The percentage using 4.00 lakhs of rupees are 60%. So average value of working capital for this district is about 3.64 lakhs rupees per unit (Table 5.9).

Table 5.9

Distribution of Units by Size of Working Capital (1989-90)

Size of Working Capital (Value in Lakh Rs.)	Number of Units
(1)	(2)
Below -- 2	--
2 -- 4	6
	(60.00)
4 -- 6	4
	(40.00)
Above -- 6	--
Total	10
	(100.00)
Average Value (Rs.)	363826.30

Note: Figures in brackets indicate the percentage to column total.

5.12 Productive capital of OPS Units:

Productive capital represent a combination of Fixed Capital and Working Capital taken together. Around 50 per cent of the total units taken together are found in the size group Rs. 6 to 8.00 lakhs. In the remaining size groups 40 per cent units found in the group of Rs. 8-10.00 lakhs and 10 per cent found in the group of Rs. 4-6.00 lakhs. There is no unit has been found in size groups of below Rs. 4.00 lakhs and above Rs. 10.00 lakhs. The average size of productive capital in Bijnor works out to be Rs. 7.55 lakhs (Table 5.10)

Table 5.10

Distribution of Units by Size of Productive Capital in Bijnor (1989-90)

Size of Productive Capital (Value in Lakh Rs.)	Number of Units
(1)	(2)
Below -- 4	--
4 -- 6	1
	(10.00)
6 -- 8	5
	(50.00)
8 -- 10	4
	(40.00)
Above -- 10	--
Total	10
	(100.00)
Average Value	755164.00

Note: Figures in bracket indicate the percentage to column total.

5.13 Capital Involved in Sample Khandsari Units in Distt. Bijnor:

For the establishment, Khandsari units also required Fixed and Working capital. Table 5.11 shows the Fixed Capital, Working capital and Productive Capital for the ten Khandsari sample units of district Bijnor. It also shows the average requirement per unit capital for this district. It also depicts the value of sugar as an output in money term and the Gross Value of output including the value of main and by-products.

5.14 Employment Structure in OPS Units:

The Khandsari industry like sugar industry, is purely a seasonal industry in which sugarcane crushing is carried for around seven months every year. Thus, it does not offer much scope for offering opportunities of regular employment. However, each unit has to have some key persons at the time crushing begins and so they have to be retained by the units on a regular basis. These persons may be the manager, production supervisor, accounts clerk and security guard, etc. The actual number of persons employed on a regular basis differs from one unit to the other, depending on its requirements.

The main dependence of the Khandsari units is on the casual workers who are employed on a daily wages basis during the crushing season. The units of the district Bijnor have a wide range of employment on

Table 5.11

**Capital Involved and Gross Value of Output in Sample
OPS Units of Distt. Bijnor (for the Year 1989-90)**

Units	Total Fixed Capital (Rs.)	Total Working Capital (Rs.)	Total Productive Capital (1+2) (Rs.)	Value of Sugar Produced (Rs.)	Gross Value of Output including By-products (Rs.)
	(1)	(2)	(3)	(4)	(5)
Unit 1	386535	420056	806591	6024822	7718058
Unit 2	159061	353842	512903	4036262	4591353
Unit 3	280781	469365	750146	3879489	5874138
Unit 4	500000	450000	950000	6300000	6762000
Unit 5	300000	360000	660000	3720705	4422280
Unit 6	500000	340000	840000	6605735	7061735
Unit 7	437000	300000	737000	6633775	7586275
Unit 8	400000	280000	680000	6831000	7983000
Unit 9	550000	245000	795000	6024800	6937090
Unit 10	400000	420000	820000	4031000	4336250
Total	3913377	3638263	7551640	54087588	63272179
Average Value (Rs.)	391337.70	363826.30	755164.00	5408758.80	6327217.90

daily wages basis. There are some units, where the daily employment is around 100 persons ranging about 180 persons in a unit. There is no unit, has been found at the field survey, having Female workers or child workers in district Bijnor (Table 5.12).

5.15 Capital Efficiency of VPS and OPS:

Capital efficiency seen in terms of per worker value of fixed capital, working capital and productive capital all go to indicate that the OPS industry is a traditional one as compare to VPS mill, since all the figures whether for individual unit or combined figures, are very low. The overall value of fixed capital per worker was not even Rs. 3000.00 and that of working capital also not Rs. 3000.00 per worker but at the same time these values for VPS unit per worker in Rs. 49,482.53 for fixed capital and 43,680.50 for working capital. In the case of productive capital per worker the figure was slightly higher as Rs. 5,652.42 but very high in V.P.S. Rs. 93, 163.12 per worker. Between the two systems of producing sugar, VPS had a higher capital efficiency (Table 5.13).

We, therefore, find that, between the two techniques (VPS and OPS), VPS has a higher level of investment in land and building, plant and machinery and working capital. Consequently, the productive capital is also higher. This, in turn, is reflected in the high capital efficiency in VPS, as well. Table

Table 5.12

Employment Structure in Sample Units of OPS Workers in Distt. Bijnor (Year 1989-90)

	Unit I	Unit II	Unit III	Unit IV	Unit V	Unit VI	Unit VII	Unit VIII	Unit IX	Unit X	Total
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Regular Employment											
Male:	7	5	6	5	5	5	7	6	8	8	62
Female:	-	-	-	-	-	-	-	-	-	-	-
Child:	-	-	-	-	-	-	-	-	-	-	-
Temporary or Sesonal Employment											
Male:	100	100	110	109	100	150	175	100	150	180	1274
Female:	-	-	-	-	-	-	-	-	-	-	-
Child	-	-	-	-	-	-	-	-	-	-	-
Total Employment	107	105	116	114	105	155	182	106	158	188	1336

Note: Seasonal Workers usually appointed for 7 month in a year i.e. October to April.

Table 5.13

**Value of Fixed, Working and Productive Capital per Worker &
Sugar Output, Gross Value of Output per Worker
(Distt. Bijnor, Year 1989-90)**

S.No.	V.P.S. Units	OPS Units
(1)	(2)	(3)
1. Value of Fixed Capital per Worker (Rs.)	49482.53	2929.17
2. Value of Working Capital per Worker (Rs.)	43680.58	2723.25
3. Value of Productive Capital per Worker (Rs.)	93163.12	5652.42
4. Value of Sugar Output per Worker (Rs.)	158309.16	40484.72
5. Value of Gross Output per Worker (Rs.)	218183.52	47359.41

Worker and gross value of output per worker is very high in VPS as compare to OPS units.

5.13 also shows, Sugar Output per-worker and gross value of output per worker is very high in VPS as compare to OPS Units.

5.16 Comparison of Fixed Capital Costs in VPS and OPS:

This is the important point for our evaluation of the two techniques of producing crystalline sugar is the comparison of their capital costs.⁸ The capital costs considered are present costs which are actually relevant for purposes of estimating future needs. Accordingly, the capital costs of a VPS sugar mill namely "U.P. State Sugar Corporation Ltd" Chandpur of Distt. Bijnor have been collected by me at the time of field survey, with a daily crushing capacity of 4,000 tonnes. For the OPS plant informations were also collected from the same district for a capacity of 100 TPD. The data is summarised in the Table 5.14.

The calculation for a VPS unit an annual production of 2,35,347 quintals of sugar in the year 1989-90, a recovery of about 9.5 per cent and 140 days crushing season. The corresponding production, recovery rate and duration of crushing season are found 9,110 quintals, 6.27 per cent and 130 days respectively for an OPS unit. Obviously, under different recovery rates and crushing season, the capital requirement per unit of output differ as they

8. Refers to investment in fixed assets like land, building, Plant-machinery etc.

Table 5.14

Fixed Capital Cost
(Value in Lakh Rs. Year 1989-90)

S.No.	Norms	VPS Units	OPS Units
	(1)	(2)	(3)
1.	Crushing Season (days)	140	130
2.	Capacity (TCD)	4000	100
3.	Recovery (%)	9.5	6.27
4.	Value of Land (Rs. Lakh)	52.18	1.00
5.	Value of Building (Rs. Lakh)	220.73	1.50
6.	Value of Plant & Machiner (Rs. Lakh)	104.13	2.50
7.	Total Fixed Value (Rs. Lakh)	377.04	5.00
8.	Output Qt. of Sugar (1989-90)	235347	9110
9.	Fixed Capital per Qt. of Sugar Produced (Rs.)	160.20	54.88

influence the aggregate production. It is well known that both the recovery rates and crushing seasons widely differ from state to state. For instance in 1976-77 the recovery rates ranged from a low of 8.42 per cent in Pondicherry to a high of 10.84 per cent in Maharashtra with an all India average of 9.91 per cent for the large scale sector. In the same year Bihar had less than 90 days of crushing season while Haryana, Uttar Pradesh, Maharashtra and Tamil Nadu had a crushing season in excess of 150 days. From the above trends, the recovery rate for the large scale sector appears reasonable, the crushing average of 125 days. On a realistic survey based of 140 days of crushing season and 9.5 per cent recovery, the capital cost of a large-scale sector worked out at Rs. 160.20 per quintal of sugar produced. On the other side the capital cost of an OPS sector worked out at Rs. 54.88 per quintal of sugar. Thus there is a saving of Rs. 105.32 per quintal in fixed capital if OPS Khandsari units are promoted in the country, specially in the state Uttar Pradesh, in place of large scale sugar mills.

In the fixed investment of a VPS unit the expenditure on housing for the employees are included while this expenditure in OPS is not found in any unit at the time of field survey. If the expenditure on the housing for the employees is excluded from the

investment of VPS units - the savings in capital costs would be less than the amount indicated above.

5.17 Labour-Output Ratios for VPS and OPS:

For calculating the labour co-efficient per unit output, the total mandays for productivity a given output has been estimated for the two techniques of sugar production. The total mandays employed for the large and small scale units have been arrived at by aggregating the number of mandays worked by seasonal and permanent staff for the year 1989-90. With the help of this data the quantity of sugar produced in this year, the labour employment days per tonne of sugar produced has been calculated and is presented in Table 5.15.

Table 5.15
Employment Per Unit Output in 1989-90

		Total Mandays	Mandays per tonne of Sugar produced
(1)	(2)	(3)	(4)
Large	Unit I	240400	1.88
	Unit II	152400	6.47
	Unit I	20116	15.31
Small	Unit II	35344	33.45

The above data shows that the labour input per tonne of sugar produced in OPS unit is about 5 times that of Large unit. This vast difference in the labour input levels between these two categories of

units is mainly due to the manual handling of materials by OPS units. During my field investigations, it was found that the following operations, which are mechanically performed by large units, are done with the help of men by small-scale units:

- 1 - Movement of sugarcane from weighing platforms to crushers.
- 2 - Carrying juice through different processes.
- 3 - Bagasse movement for sun drying and bringing it back.
- 4 - Sugar movement from sun drying where driers are not installed.
- 5 - Bagging of sugar.
- 6 - Firewood charging and its transport from stockyard.

The large mills can not resort to manual operations of the above processes as they have to handle vastly larger quantities. Although, differences are reported in the indirect employment generated by OPS and VPS sectors, here only direct employment has been considered. So it is very clear, by the above statements that VPS is a capital intensive technique of producing crystal sugar, while OPS is a labour intensive technique for the production of the same.

CHAPTER 6

INPUT USE EFFICIENCY AND COST OF PRODUCTION

Sugarcane is the main raw material for sugar industry whether it is based on VP or OP technology. The cost of sugarcane accounts for a large proportion of total production cost. On an average it accounts for about 70 per cent of the total cost. It is, therefore, necessary that adequate quantity of sugarcane is available on a regular basis. The production of sugarcane like other agricultural commodities is subject to natural vagaries and so the working of sugar producing unit is beset with uncertainty. The greatest weakness of this industry lies in its agro-based character. Cotton, Jute, Tobacco industries etc. are also agro-based, but the difference between these agro-based industries and sugar is that while the raw materials for cotton textile, jute industries, etc. can made available from the quantities stored in ware-houses, or from far-off countries, in the case of sugar industry it is not possible as cane is semi-perishable and hence it can not be stored for a long period. The raw material for it therefore, has to be procured locally or at best from a short distance taking minimum of time in transportation. Sugarcane has to be cut from fields and it has to be transported immediately to some

nearby sugar factory or sugar processing center and there it must be crushed and juice converted into sugar without loss of time. The reason is not far to seek. The sugarcane is a juicy plant and when exposed to sun after its cutting, its juice dries up and the recovery falls down. Not only that, even when the sugar plants remain standing in the field for a long time during summer season, the recovery declines.

The semi-perishable nature of sugarcane crop also limits the options for the cultivators. They have to sell their sugarcane within a very short period otherwise it will go dry and they would be put to a great loss. The farmers can not store it. In years of surplus cane production bargaining capacity of farmers vis-a-vis processors becomes very weak. In 1978-79 and 1981-82, when sugarcane was in surplus supply, farmers were forced to burn their standing crops as it could not be disposed off. In the years of surplus supply, the position of sugar factories also becomes a bit odd, because they are compelled both by Government and the public opinion to prolong their crushing season. This in turn often results in sugar industry suffering a loss during the summer months cane gets dried up and consequently recovery falls down to the minimum. The Indian Sugar Mills Association in its memorandum submitted in 1983 has stated "while in year of surplus cane it falls to the lot of sugar mills to crush additional cane by

prolonging the season into hot summer months, when the working becomes highly uneconomical."¹

The working of the sugar industry is not only conditioned by the availability of sugarcane from the nearby areas but also by such factors as natural calamities, occurrence of pests and diseases, that affects the quality of cane. This apart uncertainty of supply of sugarcane to sugar factories is also caused by the competition for sugarcane from other sweetening material producers i.e. khandsari and gur, specially during the periods of short supply of sugarcane. Generally about 30 per cent of cane produced goes to sugar factories and the rest is utilised for manufacturing of khandsari sugar and gur.

The problems of sugar factories are aggravated more during the season of short cane supply. The Gur and khandsari, being free from controls, become stronger contestants for the cane supply. In such seasons, the producers of Gur and khandsari usually pay higher prices for sugarcane and thus sugarcane supplies are diverted to Gur and khandsari manufacturing from sugar industry. The ISMA in its memorandum submitted to the Bureau of Industrial Cost and Prices in 1983, had rightly stated, "when the cane crop is short, the producers of Gur and khandsari pay unduly high cane prices to divert it from sugar

1. Memorandum to the Bureau of Industrial Costs and Prices, ISMA, Sugar House, New Delhi, 1983, pp. 96-97.

factory areas. This induces the cane grower to expand his cane acreage and consequently, sugar can production. But when the production of sugarcane goes up the khandsari and commercial Gur producers reduce their prices to highly uneconomic levels. In cane glut years wide disparity invariably exists between the prices which the sugar factories pay and the prices which Khandsari and Gur producers offer. This not only results in diversion of cane in reverse direction but also leads to shrinkage in cane acreage and consequently, low cane production².

Like the OPS units, the cane growers have also complete freedom with regard to the selection of crop which they would grow. The ups and downs in the cane production is the main source of uncertainty for the sugar manufacturing units. The area under sugar cane, the varieties of cane selected for planting, weather conditions during the planting and growth period of cane crop along with irrigational facilities and availability of crucial farm inputs like diesel and fertilizers have important bearing on sugarcane production.

Total cane production depends on acreage under the crop and the productivity of sugarcane per hectare. The higher the productivity per acre with acreage remaining the same, the more supply of

2. Memorandum to the Bureau of Industrial Costs and Prices, ISMA, Sugar House, New Delhi, 1983 pp.97-98.

sugarcane to the different segments of sugar industries i.e. VPS and OPS can become available. The productivity per hectare in India has been increasing at a 2.08 per cent per annum during 1979-80 to 1988-89 but the growth path has not been smooth rising curve it has been marked by ups and downs in different years. However, it is important to note that the productivity of sugarcane per hectare has risen during the plan periods by about 75 per cent and thus has played an important role in any augmenting the supplies of sugarcane to sugar industry and khandsari units.

Increase in production of sugarcane does not necessarily imply an increase in supply of sugarcane to sugar industry. Sugar industry has to work under certain constraints such as the minimum statutory prices of sugarcane and the prices fixed by the State Government, control on sugar production, sale and prices by the Government. But such controls are either minimum in the case of Gur and Khandsari or are not at all. This gives an added advantage to Gur and khandsari industry as far as competition for sugarcane is concerned. It is true, that the overall output of sugarcane has an important impact on utilisation of sugarcane for sugar manufacture, but it is the demand for sugarcane for Gur and khandsari that influences considerably the availability of sugarcane to vacuum pan factories. The gur and khandsari industry has more manoeuvre availability as far as prices they can

pay for sugarcane are concerned particularly whenever the prices of Gur and khandsari are high.

Sugar industry is a very sensitive industry. It is always affected in respect of cane supply due to natural phenomena, such as floods, droughts, pests, insects, diseases on the one hand and competition from the other sweeteners on the other. As a result, there has been wide fluctuation in production of sugar. The quality of sugarcane too has an important role in the quantity of sugar production. Inspite of the improved varieties developed by our research centers and planted by our farmers, the situation has not improved. The reason is that the quality deteriorates within a few years due to flood, water-logging etc. All these affect production. Since 70 per cent cost of sugar production is accounted for by sugarcane, one must give full attention towards the development and protection measures for this crop.

6.1 Cost of Production:

The various elements that constitute the cost structure of sugar production are as follows:

1. Cost of raw material i.e. sugarcane, sulphur, lime, other chemicals, etc.;
2. Cost of Fuel, i.e. Electricity, Diesel, Bagasec, Fire wood, coal, etc.;
3. Wages, salaries, bonus and other charges;

4. Packing charges;
5. Taxes;
6. Depreciation;
7. Emergency risk insurance charges;
8. Export loss;
9. Miscellaneous expenses

The cost structure of sugar production discussed below is based on the information collected from two VPS and ten OPS units selected from Bijnore district in U.P. is given in Table 6.1 and Table 6.2.

The Tariff Commission Report 1973 on the cost structure and fair price payable to the sugar industry had adopted the average duration and average recovery for each of the zones for the five year period on the pattern of the Tariff Commission Report 1969. The cost of raw materials includes the cost of cane purchased at the factory gates and the outstation purchase centres. Broadly speaking, the cost of raw materials comprises of (a) the cost of cane, (b) cane development expenses and (c) Transport charges.

1. The minimum price of sugarcane notified by the Government is ex-gate and there is a provision for a rebate of 32 paise per quintal if the cane is transported by the sugar factory from outstation cane centres. Provision for cane transport charges has been made for all the zones

Table 6.1

Value of Total Input Use in Two Sugar Mills of Distt. Bijnor (1989-90)

S.No	Components	(Value in Lakh Rs.)	
		Unit I	VPS Mills Unit II
1.	Sugarcane	5,623.00	763.00
2.	All Chemicals Used	387.00	51.00
3.	Fuel	256.00	7.00
4.	Depreciation	645.00	578.00
5.	Other Expenses*	1,199.00	50.00
6.	Taxes	230.00	50.00
7.	Wage & Salary	643.00	116.00
8.	Total (a) Including Wage & Salary	8,983.00	1,615.00
	(b) Excluding Wage & Salary	8,340.00	1,499.00
9.	Crushing Capacity per day (TCD)	5,000.00	4,000.00

* Includes Miscellaneous Expenses and Rent if any.

Note: Details of total Input use for the two sugar mills of Distt. Bijnor is given in Appendix Table 3.

Table 6.2

Value of Total Input Use in Ten Khandsari Units of Distt. Bijnor
(1989-90)

SNo.	Components	(Value in Thousand Rs.)									
		Unit I	Unit II	Unit III	Unit IV	Unit V	Unit VI	Unit VII	Unit VIII	Unit IX	Unit X
1.	Sugarcane	5188	3065	3316	4500	2600	5200	5880	5900	4700	2700
2.	Chemical use	133	197	98	149	147	137	140	154	303	143
3.	Fuel	404	181	297	321	297	258	350	396	120	338
4.	Rent if any	-	-	-	-	6	-	-	-	-	-
5.	Miscellaneous	7	3	7	20	5	23	5	9	59	7
6.	Other Expenses	677	137	1210	142	278	120	145	393	339	143
7.	Taxes	100	82	67	150	100	160	100	100	100	100
8.	Depreciation	100	21	107	89	37	95	100	50	100	200
9.	Wage & Salary	875	548	446	388	400	460	600	580	980	500
10.	Total Including										
A.	Wage & Salary	7484	4234	5548	5759	3870	6453	7320	7582	6701	4131
B.	Excluding Wage & Salary	6609	3686	5102	5371	3470	5993	6720	7002	5721	3631

Note: Details of total input use for the Ten Khandsari Units of Distt. Bijnor, is given in Appendix Table 4.

after taking note of the rebate of only 32 paise per quintal of sugar.

2. The cost of power has several components such as the cost of coal, fire wood, bagasse and charges for power from other external sources.
3. The VPS factories have to pay several taxes i.e. octroi hired by municipal committees on cane entering sugar factories, income-tax, corporate tax, capital gain tax, market fees and central excise duty. Besides, they have to defray the amount of cane cess/purchase tax and sale tax on sugarcane and stores purchase. They have also to pay the weighment fees, land rent, electricity dues and commission to the cooperative unions. The local authorities also levy several taxes on the sugar factories i.e. the Panchayat tax, the Chaukidari tax and the Road permit fees. The sugar factories in addition to all these taxes and commission, are liable to pay license fees.
4. Packing costs include the cost of gunny bags which is subject to fluctuations. The tariff commission 1973 had provided escalation for variations in the price of gunny bags in addition to freight. Packing cost is a part of the cost of sugar cost schedule.
5. The tariff commission, 1973 had decided in favour of continuing the existing method of computing the quantum of depreciation on the basis of zonal

averages of costed units. For this purpose the commission followed the written down value added in accordance with the income tax rules.

6. The insurance charges have got to be paid by the factory at any cost and as such they are also included for this purpose under the Emergency Risk Insurance implemented in 1962.

Thus total cost of production of sugar may conveniently be divided into the following main categories:

- (a) the cost of cane
- (b) the burden of taxes, and
- (c) the manufacturing or conversion cost.

On the other hand, OPS units have many advantages as compared with VPS units, OPS units are free from minimum price of sugarcane notified by the Government, they have not to pay transportation charges as they procure sugarcane only at the processing site. Farmers generally bring their cane on bullock cart at the gate of khandsari units and for that they don't charge any money from OPS units. OPS units are free from excise duty etc.

6.2 A Comparison of Production Cost in VPS and OPS:

A feature which has been highlighted by various authors and agencies is the wide divergence in the

manufacturing costs of large sugar mills (VPS) in the country. The levy price of sugar fixed for different zones in 1989-90 indicates that while for factories in South Bihar was fixed at Rs. 643.46 it was fixed only at Rs. 450 per quintal for factories in Tamil Nadu (Table 6.3). Since in the levy price of Sugar cost of cane is uniform for all factories it is evident that conversion costs defined by as much as Rs. 200 in different zones. These differences are attributable to a host of factors, chief among them being the variations in recovery rates and in duration of the crushing season in different states. Variation in plant size and quality of management also significantly contribute to cost divergences. When such differing cost schedules exist, the selection of a sample unit, that is representative of the industry, is an extremely difficult task. The particulars of units related for detailed analysis are furnished below in Table 6.4.

The aggregate manufacturing costs per quintal of sugar produced for these units are given in Table 6.5.

The above data reveals that the manufacturing costs of khandsari units are higher than the sugar mills by about Rs. 100 per quintal in 1989-90 (when we compare manufacturing costs per quintal of sugarcane from First Unit of VPS to First unit of OPS and same difference we found when we compare second Unit of VPS to Seventh, eighth ninth and tenth units of OPS). The

Table 6.3

Sugar: Levy Prices for S-30 Grade Sugar
(excluding Excise Duty)

(Rs. per quintal)

Zone/Region	1985-86	1986-87	1987-88	1988-89	1989-90
	14.11.85	12.12.86	23.12.87	21.12.88	27.1.90
1	2	3	4	5	6
Punjab	379.97	397.50	420.42	437.12	490.96
Haryana	403.46	407.86	430.53	442.03	490.97
Rajasthan	457.27	456.94	539.83	566.58	639.54
West U.P.	425.90	428.23	453.41	462.61	529.89
Central U.P.	421.68	414.53	430.53	441.13	498.64
East U.P.	452.07	442.58	458.30	473.65	530.31
N. Bihar	445.61	436.92	453.83	474.88	528.47
S. Bihar	516.53	531.00	547.25	574.42	643.46
Gujarat	363.21				
S. Gujarat		366.96	397.36	414.83	478.17
Sourashtra		412.53	434.41	439.15	491.58
Madhya Pradesh	455.20	475.49	495.72	507.65	565.17
Maharashtra	373.64				
Maharashtra South		382.59	396.30	406.60	456.69
Maharashtra North		400.08	433.47	447.42	495.08
Karnataka	362.76	378.74	398.40	408.88	469.77
Andhra Pradesh	368.29	379.19	414.57	434.26	498.71
Tamil Nadu & Pundi.	398.51	393.54	425.38	450.38	450.22
Orissa, Assam, W.B. & Nagaland	414.74	414.41	457.33	481.65	543.35
Kerala & Goa	429.39	448.86	479.42	492.10	567.34
Average	391.24	398.34	423.00	436.00	492.00

*: Inclusive of Rs. 26/- per quintal allowed in case of factories whose licensed capacity is below 1200 tonnes per day and are more than 25 year old.

Separate prices for Gujarat and Maharashtra are from 1986-87.

Source: Ministry of Food & Civil Supplies.

Table 6.4

Particulars of Surveyed Units of Distt. Bijnor, Uttar Pradesh

(1989-90)

S.No	Components	VPS		OPS		
		Unit I	Unit II	Unit I	Unit II	Unit III
1.	Installed Capacity (TCD)	5000	4000	200	200	250
2.	Crushing Season (Days)	140	140	130	130	150
3.	Fixed Capital (Rs.Lakh)	5166	377	3.86	4.37	2.80
4.	Total Sugar Produced (in Qtl.)	1275428	327875	10041	9545	6806
5.	Total Value of Inputs In Case of VPS (Lakh Rs.)	8983	1615	7484	7320	5548
In case of OPS (Thousand Rs.)						

Table 6.5

Cost of Sugar Production in Selected Units (1989-90)

VPS and OPS Units		Rs. per Quintal
VPS		
	Unit I	704.31
	Unit II	492.56
OPS		
	Unit I	815.16
	Unit II	766.89
	Unit III	745.34
	Unit IV	639.59
	Unit V	638.21
	Unit VI	632.16
	Unit VII	603.21
	Unit VIII	598.14
	Unit IX	584.21
	Unit X	561.71

cost differential gets enlarged further if a weight is assigned to the quality of sugar produced by these two categories of units. The average cost of production in OPS sector was found Rs. 7,540 per tonne which is 26 per cent higher than the cost of production of Rs. 5,985 per tonne for VPS units when Rs. 1,200 per tonne was taken into account for quality differences in the sugar produced in the VPS and OPS units. Without this adjustment average cost of production of sugar for OPS units was higher than the cost of products in VPS, only 6 per cent.

The cost of sugarcane in the total cost of sugar production were always found to be higher for OPS units than VPS mills. The chief reason for the higher sugarcane costs is mainly the lower recovery of sugar in the former. Recovery rates of sugar for the selected VPS and OPS units of Distt. Bijnor are presented in the table 6.6.

From the data in table 6.5, it is apparent that the recovery of sugar in khandsari units is lower by nearly 3.5 per cent. For producing a quintal of sugar a VP unit with a sugar recovering of 9.5 per cent would require 10.52 quintal, of cane and an OP unit available to recover only 6.4 per cent sugar would requiring 16.55 quintal, of cane. This loss in recoverable sugar is one of the chief reasons for higher manufacturing costs, in OP units.

Table 6.6

Per cent Sugar Recovery in VP and OP Units in Distt. Bijnor,
Uttar Pradesh (1989-90)

S.No	Sugar Recovery		
	OP Units	VP Mills	Difference
1.	6.00	9.50	3.50
2.	6.02	9.50	3.48
3.	6.02	9.50	3.48
4.	6.27	9.50	3.23
5.	6.02	9.50	3.48
6.	6.10	9.50	3.40
7.	6.02	9.50	3.48
8.	6.02	9.50	3.48
9.	6.00	9.50	3.50
10.	6.02	9.50	3.48
Average	6.04	9.50	3.46

The other elements that cause escalation in the manufacturing costs of an OPS units are power, fuel and stores and wages and salaries. Though these units pay lower emoluments to their employees, their wage bill per unit of sugar produced is higher as they employ more persons. The expenses on power, fuel and stores are also found to be higher as under the open pan sulphitation process, the heat losses are higher.

The forgoing section presents cost structure in terms of inputs use as such but not the social costs which also enter into the process of production. Hence the following methodological issues are discussed and investment costs of the individual units are presented for discussion.

6.3 Methodology to Calculate Social Costs:

A social cost-benefit analysis is increasingly being taken recourse to when commercial profitability alone cannot be taken as the sole determinant of a choice between two alternative projects. The study "Sugar Processing Techniques in India"³ used this technique to ascertain the social costs and benefits of OPS and VPS mills in India to determine in what circumstances the expansion of large scale sugar production is justifiable. The use of social cost-benefit analysis for measuring the 'real benefit of

3. Baron C.C.: Technology and Employment in Industry (Chapter 7), International Labour Office, Geneva, 1975.

sugar production' in the Indian Sugar Industry presents certain difficulties. These arise from:

non-uniformity in the manufacturing costs of individual mills and
quality differences in the sugar produced by VPS and OPS mills.

For computing the 'real opportunity costs of production' of VPS and OPS units, following equation has been used in several studies.

$$PV(C) = \sum_{t=0}^n \frac{C_t}{(1+i)} + I.P_t$$

i.e. real opportunity costs of production for either technology is computed in terms of present value. In the above equation

C_t = Total running costs

I = Initial Capital investment requirement

P_t = The Shadow price of investment funds

i = Social rate of discount

By assuming that, one time investment is followed by a constant stream of costs each year and that the machinery has a long life the above expression can be simplified as follows:

$$PV(C) = \frac{C}{i} + I.P.i$$

A.K. Sen and M. Dutta-Chowdhry⁴, have estimated the shadow price of investment according to the following formula:

$$P_i = r (1-a)/(i-ar)$$

Where

a = rate of re-investment of profits

r = rate of return on investment in the economy

i = Social rate of discount

Assuming a rate of return on investment of 20 per cent and a social rate of discount of 10 per cent, Baron had worked out the value of P_i as 2.67. This figure indicating the present value of the aggregate consumption foregone, because of Rupee investment in sugar production. The value obviously will be different, when different social rates of discount are assumed.

It is well known that in India, the duration of the crushing season as well as the prices paid for sugarcane vary from year to year. The sugar mills in different states have different crushing seasons, even in Uttar Pradesh level of sugarcane production can elongate or shorten the crushing season. In years of good sugarcane crop, mills work for longer periods to

4. Sen A.K. and Dutta Chowdhry M.: Durgapur Fertiliser Project: An Economic Evaluation, Indian Economic Review, Vol. V. No.1, April, 1976.

complete the crushing of available cane while, during scarcity periods, they curtail their operations. On the other hand OPS mill shorten their crushing season during years of plentiful supplies of sugarcane and extend it when the availability is low. Similarly the prices paid also vary from season to season. According to the Government policy, the minimum prices payable to cane growers by VPS mills are linked to the recovery level. As the recovery rates differ from region to region, sugarcane prices also vary both over time and space. The assumption of Baron on the "fixity" of crushing season for OPS units and variability for VPS units has therefore no empirical basis. The calculation of present values has not been attempted for varying crushing seasons or prices.

While calculating the present values, Baron had assumed certain costs to be fixed irrespective of the duration of the crushing season. In respect of OPS units, the expenditure on repairs and renewals, fuel power and chemicals, overheads, contingencies and wages and salaries was assumed to be the same for a season of 200 days or 100 days. On the other hand for VPS units, repair and maintenance and wages and salaries have been held constant for the three crushing seasons of 200, 150 and 100 days. It is not clear how such an assumption has been made. Both VPS and OPS mills pay wages to their seasonal workers for the period worked during the crushing season.

Similarly, the expenditure on fuel, power and chemicals also varies proportionately with length of crushing season. It is therefore, not realistic to assume that these costs will remain constant for different crushing seasons if one were to be consistent, all the variable costs like wage and salaries, materials and chemicals, fuel and power etc. will have to be estimated to different durations of crushing season. To do this, one would have to make several assumptions, that may not be realistic.

Usually, a higher social value is attached to a technique of production that provides more employment, but also pays a comparable wage. It is no so in the case of sugar industry in India. The VPS sector though it employs less number of persons for a unit output, the wage costs of its units are comparable to those of OPS units. The latter, however, provide 4 to 5 times more employment for the same output (See 5.17).

6.4 Investment Costs:

The minimum cane price fixed by the Government for the year 1988-89 season was Rs. 19.50 at a recovery rate of 8.5 per cent. The processing costs were taken from NCAER (1983) and upto date for the year (1989-90). Here, the information available on investment requirement is for a unit of 1250 TCD. The investment requirements for two sample units have been

estimated with the help of William's six-tenths formula. A similar procedure has also been adopted for OPS units.

The present value calculations for both the categories of units at a social rate of discount for 10 per cent are presented in table 6.6. A comparison of annual equivalent costs per quintal of sugar under the two technologies does not reveal any advantage for the OPS sector. On the other hand, the VPS units seem to have an edge over khandsari units (Table 6.7).

It is, however, admitted that comparison of the two technologies of sugar production for purpose of policy formulation has a serious limitation as the conditions under which both the categories of units operate significantly differ.

The VPS sector has been operating under government regulations which extend from input costs to distribution of output and then prices. Even during period of de-control, the fixation of wage and sugarcane prices payable to sugarcane growers have been regulated by government. On the other hand, the OPS sector is relatively free from such regulations. Moreover, the informal control exercised by the Government on crushing season of a VPS mills is absent in case of the OPS sector. This makes a significant difference in the cost structure. In some seasons, the sugar mills were compelled to extend the season to complete the crushing of available sugarcane in almost

Table 6.7

Present Value of Costs in VPS and OPS (1989-90)

Item	VPS Sector		OPS Sector	
	Unit I	Unit II	Unit I	Unit II
(1)	(2)	(3)	(4)	(5)
1. Cost of Cane	780.99	1615.65	85.38	68.13
2. Wage and Salaries	121.17	295.23	13.29	12.51
3. Other Material Inputs	110.91	107.19	9.09	12.60
4. Repair & Maintenance	42.90	128.25	5.07	4.77
5. Administrative Overheads	232.50	328.17	6.21	7.53
6. Total Running Costs (Addition of line 1 to 5)	1288.47	2474.49	119.04	105.54
7. Present Value of Running Costs (discount Rate 10%)	12884.70	24744.90	1190.40	1055.40
8. Investment Cost*	2774.01	3813.90	72.63	72.63
9. Weighted Investment Cost	7406.61	10183.11	193.92	193.92
10. Present value of all Costs (Addition of line 7 & 9)	20291.31	34928.01	1384.32	1249.32
11. Present Value per Qtl. (Rs.)	10305.00	8469.00	10929.00	11907.00
12. Annual Equivalent per quintal (Rs.)**	1030.00	846.00	1092.00	1190.00

* $X_w = (w/o)^6 X_0$, where X_w is the investment cost (estimated) for w tonne capacity and X_0 actual investment cost for 0 tonnes. (For VPS: $o = 1250$ MT; $X_0: 610.06$ (lakh Rs.); Khandsari: $o = 80$ MT, $X_0 = 12.22$ (lakh Rs.)

** $P_i = 2.67$

*** The present value is converted to an annual equivalent by multiplying rate of interest (10%).

all the states. In such years the crushing season got extended to the summer months when recovery rate fall rapidly. On the other hand, with no such interventions, OPS unit can select their own crushing period which gives them a advantage in their average recovery rate.

6.5 Total Value of Output In Sample Units of VPS & OPS:

The total value of output produced by the two sample sugar mills of Distt. Bijnor namely - Dhampur Sugar Mill Ltd. and U.P. State Sugar Corporation Ltd., Chandpur is given in (Table 6.8).

The total value of output produced by the OPS units are far less as compared with the total value of output of VPS units. This is mainly because of size difference, difference in recovery rate and most of the work is done - manually in OPS units, while VPS units are automatic at all most all the stages. The value of total output for ten sample units of OPS in district Bijnor is given in table 6.9.

6.6 Value Added:

After examining the total value of output and the total value of input in the two sugar mills and ten sample khandsari units of Distt. Bijnor let us

Table 6.8

Value of Total Output in Two Sugar Mills of Distt. Bijnor

(Year 1989-90)

S.No.	Item	Unit I (5,000 TCD)		Unit II (4,000 TCD)	
		Value (In Rs.)	Quantity (Qtl.)	Value (In Rs.)	Quantity (Qtl.)
(1)	(2)	(3)	(4)	(5)	
1.	Main Product (Sugar)	890775757	1275428	164272705	235374
2.	By Product (Mainly Molasses)	14138979	471299	1983142	66104
	Total Value of Output	904914936	1746727	166255847	301478

Table 6.9

Gross Value of Output of Sample OPS Units in Distt. Bijnor

No. of Unit		Value of Output (1988-89)	Value of Output (1989-90)
(1)	(2)	(3)	
Unit I		1,02,21,650.00	77,18,058.00
Unit II		86,09,667.00	45,91,353.00
Unit III		47,88,914.00	58,74,138.00
Unit IV		67,94,000.00	67,62,000.00
Unit V		60,70,130.00	44,22,280.00
Unit VI		71,95,998.00	70,61,735.00
Unit VII		1,04,01,000.00	75,86,275.00
Unit VIII		1,04,37,000.00	79,83,000.00
Unit IX		66,01,000.00	69,37,090.00
Unit X		68,04,000.00	43,36,250.00

examine then Value Added* in the two systems. Value added for the two sugar mills is given in the table 6.10.

Table 6.10

Value Added in Two Sugar Mills of Distt. Bijnor

(1989-90)

	Sugar Mill I (5,000 TCD)	Sugar Mill II (4,000 TCD)
Gross value of output	90,49,14,736.00	16,62,55,847.00
Gross value of input	83,43,81,897.00	15,00,94,579.00
Value added	7,05,32,839.00	1,61,61,268.00

The value added in Dhampur sugar mill is very high as compared with Chandpur sugar mill which is a state Government undertaking mill. Dhampur sugar mill is a private sugar mill and crushed sugarcane efficiently as reflected by total crushing exceeding the crushing capacity while Chandpur mill was not working well at the time of field survey and the supply of cane was also short. The reason for the better performance of Dhampur mill is better management and its higher crushing capacity. As a matter of fact, at the time of field survey it is

*. Value added = (Gross Value of output - Gross Value of Input) where, Gross value of input includes depreciation but without taking wage and salaries in account.

found that Dhampur sugar mill was crushing with a capacity 8,500 TCD with abundant of sugarcane supply while on the other hand Chandpur sugar mill was not working properly due to short supply of cane at its gate.

When we look into the value added by OPS and VPS units, it is found that value added by VPS units are high as compare to OPS, although OPS units are producing reasonable production and creating good value added but due to the less recovery in OPS it is not in position to stand against VPS units even in value added. Value added for the ten sample units of OPS is given in Table 6.11 for the two years (1988-89 and 1989-90).

When we compare the different variables like the value added per factory, value added per employee, share of inputs in outputs in percentage term, share of value added in output in percentage term between Chandpur Sugar Mill (VPS), and one OPS unit out of ten khandsari units, following picture emerges:

- Value added per employee in Khandsari unit is only 48.77 per cent of the large VPS unit.
- Share of value added in output is higher in the Khandsari unit.
- Input costs in large-scale sector are higher by 4.6 per cent.

Table 6.11

Value Added for Ten Khandsari Units of Distt. Bijnor

(Year 1988-89 & 1989-90)

OPS (1)	For Year 1988-89 (2)	For Year 1989-90 (3)
Unit I	10,84,734.00	11,06,954.00
Unit II	11,41,657.00	9,03,454.00
Unit III	4,10,622.00	7,68,169.00
Unit IV	9,56,800.00	13,91,000.00
Unit V	9,28,630.00	9,50,230.00
Unit VI	8,73,498.00	10,68,735.00
Unit VII	10,66,800.00	8,64,575.00
Unit VIII	13,41,914.00	9,81,200.00
Unit IX	12,85,600.00	12,15,690.00
Unit X	8,78,800.00	7,03,050.00

- Due to higher pay-scales and other benefits the share of emoluments in value added is higher in large scale units (Table 6.12).

Table 6.12
**Value Added and Value Added per Employee
in VPS and OPS Units**

Item	(1989-90)	
	VPS	OPS
(1)	(2)	(3)
Output (Lakh Rs.)	1,663.00	77.00
Total Input (Lakh Rs.)	1,501.00	66.00
Value added (Lakh Rs.)	162.00	11.00
Value added per employee (Rs.)	21,209.01	10,345.36
Share of Inputs in output (%)	90.27	85.65
Share of value added in output (%)	9.72	14.34
Share of emoluments in value added (%)	70.97	60.71

On the basis of comparative costs of production and input use efficiency of VPS and OPS units, the merits and demerits may be summarised as follows; it has been found that production costs of Khandsari units (OPS) are higher by about 26 per cent as compared to those of large sugar mills. The cost escalation of OPS units is mainly owing to their excessive use of sugarcane per unit output. The higher consumption of sugarcane per unit production is

because of the lower recovery rate of sugar which is 3.46 per cent lower than that of large sugar mill (See Table 6.5). A part of the escalation of manufacturing costs of OPS units is also explained by their higher conversion costs. Khandsari units employ more mandays per tonne of sugar produced as compared to VPS mills (See 5.17). The capital costs are lower for OPS units. The cost of production of sugar is high because of inadequate utilisation of by products and the seasonal character of the industry. At present sugar is produced either by sulphitation or carbonation process. In both these processes, sulphur is used which is imported at a very high price increasing the cost of production. The sulphitation processes the use of sulphur varies from 0.05 to 0.08 per cent while in carbonation process it varies from 0.02 to 0.035 per cent⁵.

The most vital factors that affect the cost schedule are the quantity of cane crushed and duration of crushing season. "Any sugar mill that operates at 40 to 60 per cent of the normal crushing season must face sickness in spite of its being highly efficient⁶.

Most of our sugar mills in Uttar Pradesh are incurring losses due to old machineries thus require immediate replacement of old machines to modernise

5. "A valuable Foreign Exchange Earner", Yojana, Vol.XXI, No.6, New Delhi, April 15 to 30, 1977, p.16.

6. Indian Sugar, July 1973, pp. 255-56.

units. For this large amount of capital is required. On the other hand the value of plant and machinery are going up very sharply. The VPS mills are highly capital intensive, while OPS units require less capital intensive. "Between 1968 and 1986 the value of plant and machinery has escalated from Rs. 200 lakhs to Rs. 1060 lakhs, i.e. by 530 per cent.⁷ "If the past is any guide, these trend are likely to continue in future thereby increasing the gap between the requirement of funds for replacement/modernisation and its actual availability in VPS mills.

7. Long term Sugar Policy, ISMA, New Delhi, p.18.

CHAPTER 7

EMPLOYMENT IMPLICATIONS AND EVALUATION OF THE TWO TECHNOLOGIES

In the preceding Chapter we have seen that the production costs of Khandsari units are higher than those of the large sugar mills and this is mainly owing to excessive use of sugarcane per unit output in OPS units on account of recovery rate in OPS units than that in the case of large sugar mills. A part of the escalation of manufacturing costs of OPS units is also explained by their higher conversion costs. Due to these facts, VPS units seem to have an edge over the OPS units. But at the same time we have also seen that the OPS units employ more mandays per tonne of sugar produced as compared to vps mills (See Chapter 5) and capital costs are lower for OPS units (See Chapter 5, Table 5.4 & 5.11).

It is pertinent to ask as to what role the OPS units should play in the future development of the sugar industry. The answer to this question has to be based on an evaluation of the two technologies and should look into the merits and demerits of both the VPS and OPS units, specially with the reference of employment generation.

The benefits of the OPS sector are both monetary and non-monetary. The first advantage, already noted, is the lower capital cost and higher employment

potential. In a labour surplus and capital scarce economy, such as Indian, the OPS sector has a strong appeal, if no disadvantages exist that counter-balance these benefits. This issue is examined in this Chapter. In support of OPS production certain non-tangible, but socially desirable benefits are also mentioned. It has been said that they lead to a decentralised pattern of rural development which has high social priority. This point needs some amplification.

7.1 Employment Implications:

An overwhelming proportion of our country's population live in the rural areas, a sizeable proportion of them below the poverty line. Any programme that promotes rural development must enjoy high priority in the country. It is recognised that for solving the problem of unemployment it would be necessary to adopt a policy to make the pattern of production more labour intensive and to regulate technological changes so that the rate of growth of employment is maintained at a satisfactory level along with a policy to maintain the highest feasible rate of growth. It is obvious, if there is no technological change in a particular sector, employment in that sector would grow at the same rate as output. When greater labour absorption is required, employment must grow at a faster rate than

output for which adoption of a labour intensive technology may be necessary. Employment Oriented strategy by altering factor intensities in production is likely to change income distribution and consumption pattern of people also. Deliberate measures that promote the adoption of labour intensive methods of production are advocated to solve the country's twin problems of mounting unemployment and deepening poverty for which the growth oriented policies pursued in the past did not provide a satisfactory solution. Following this switch in strategy, mini sugar plants (OPS) are more appropriate in India as they maximise the use of the relatively abundant manpower resource that is not fully employed and minimises the requirements of capital, which is a scarce input.

It is common knowledge that significant difference exist in the volume of employment provided by different units in the large-scale sector due to the enormous variations in their manufacturing capacities. In Uttar Pradesh, sugar units, particularly the older ones, are compelled to carry a larger labour force since present day labour laws do not permit retrenchment of labour, which become surplus as a result of incorporation of technological improvement.¹

1. ISMA : Indian Sugar Year Book, 1977-78.

From 1936, it has been realized that OPS units are labour intensive and should be improve but it was not before the late fifties that a commercially viable production process was developed. Not only the technical improvements, but in particular the decision of the Government in 1957 to increases the rate of excise duty on crystal sugar, contributed to a rapid growth of the number of OPS units. According to WUPGKMA, the number of OPS units in the country in 1977-78, was almost 1800, of which 66 per cent were located in Uttar Pradesh an 60 per cent in Western Uttar Pradesh alone. (Table 7.1)

Regarding the pattern of employment in VPS and OPS unites, information is also available from a study conducted by National Council of Applied Economic Research. According to this study selected mills provided permanent jobs to 52 per cent of their employees which was found to be higher than the all-India average. But in Uttar Pradesh and other places, permanent employment is reported to be lower than this figure. As compared to the VPS sector only 5 to 6 per cent of the employees secure permanent employment in Khandsari Units. (Table 7.2)

Pattern of employment in our selected VPS and OPS units from district Bijnor is given in Table 7.3.

It is evident from late 7.3 that where as the first VPS unit provided permanent jobs to 38 per cent of its employees the second unit provided permanent

Table 7.1

Distribution of OPS Units during 1977-78

Area (1)	Number (2)	Share (3)
Western Uttar Pradesh	1083	60.3
Andhra Pradesh	254	14.1
Haryana	121	6.7
Rest of Uttar Pradesh	109	6.1
Karnataka	81	4.5
Gujarat	64	3.6
Maharashtra	39	2.2
Punjab	16	0.9
Rajasthan	14	0.8
Orissa	13	0.7
Madhya Pradesh	3	0.2
Total	1797	100.0

Source: WUPGHMA.

1 - ISMA, Indian Sugar Year Book, 1977-78.

jobs to 54 per cent of its employees. It may be mentioned here that first VPS unit was in the private sector, while second was in public sector. As compared with their levels only 5 to 6 per cent of the employee secure permanent employment (in Khandsari units). When we take both the VPS units together than large sugar mills provided permanent jobs to 45 per cent of their employees while the average for OPS units worked out at 5 per cent only.

Table 7.2
Break-up of Employment

Units	Daily crushing capacity	Employee			
		Permanent	Seasonal	Total	
(1)	(2)	(3)	(4)	(5)	
VPS Units =					
1	2,500	409	194	603	
2	1,600	264	390	654	
3	3,000	436	428	864	
OPS Units =					
1	250	21	424	445	
2	250	23	364	387	

Source: NCAER.

Table 7.3
Pattern of Employment in Selected Units

(for the year 1989-90)

Units	Daily crushing capacity	Employee		
		Permanent	Seasonal	Total
(1)	(2)	(3)	(4)	(5)
VPS Units				
1	5,000	452	750	1202
2	3,000	412	350	762
OPS Units				
1	100	7	100	107
2	100	5	100	105
3	100	6	110	116
4	120	5	109	114
5	120	5	100	105
6	120	5	150	155
7	150	7	175	182
8	150	6	100	106
9	150	8	150	158
10	150	8	180	188

7.2 Emoluments:

Emoluments paid to employees are also of important one to both VPS and OPS units as there form a significant component to total production costs. Now a days wage payments in sugar mills are based on the recommendations of the Third Central Wage Board (1986). According to present scale of pay, wage paid to workers in sugar mills are shown in the table 7.4. Although, in the absence of any similar regulatory mechanism applicable to Khandsari units, the wage rates were found to be lower in the Khandsari sector. The information gathered by me from individual large sugar mills and Khandsari units, from district Bijnor, further confirms the observation. The relevant data is presented in the following table 7.5

The above observation confirms the following things:

- Output as well as value added per employee was higher in the large sugar mills.
- Average annual emoluments per employee was also high in VPS units.
- Value added as a per cent of output is higher in Khandsari Units.
- Share of wages in the value added did no reveal any discernible trend.

Table 7.4
Revised Wage Structure

S.No.	Category of Workers	Revised Scale	
		From	To
(1)		(2)	(3)
A. Operative			
1.	Unskilled	-	Rs. 800 - 1050
2.	Semi-skilled	-	Rs. 900 - 1250
3.	Skilled 'B'	-	Rs. 1050 - 1600
4.	Skilled 'A'	-	Rs. 1200 - 1650
5.	Highly Skilled	-	Rs. 1300 - 2050
B. Clerks			
6.	Grade - IV	-	Rs. 1050 - 1600
7.	Grade - III	-	Rs. 1200 - 1850
8.	Grade - II	-	Rs. 1300 - 2050
9.	Grade - I	-	Rs. 1400 - 2250
C. Supervisory			
10.	Grade - C	-	Rs. 1400 - 2250
11.	Grade - B	-	Rs. 1500 - 2450
12.	Grade - A	-	Rs. 1700 - 3050

Source: 3rd Wage Board for Sugar Industry, 1986.

Table 7.5
Comparative Wage Payments (Year 1989-90)

S.No.	Item	VPS Sector		OPS Sector	
		Unit I	Unit II	Unit I	Unit II
(1)	(2)	(3)	(4)	(5)	
1.	Total Employees	1,202	762	107	188
2.	Man days worked	2,40,400	1,52,400	20,116	35,344
3.	Wage & Salaries (Rs. Lakh)	643	116	8.8	5.0
4.	Total output (Rs. Lakh)	9,049	1,662	77	43
5.	Total Input* (Rs. Lakhs)	8,344	1,500	66	36
6.	Value added (Rs. Lakhs)	705	162	11	7
7.	Value added per Employee (Rs.)	58,652	21,260	10,280	3,723
8.	Output added per Employee	7,52,829	2,18,110	71,963	22,872
9.	Value added per Manday	293.26	106.30	54.68	19.81
10.	Wage and Salaries per Employee	53,494	15,223	8,224	2,660
11.	Share of Wage in Value added (%)	91.21	71.60	80.00	71.43

* Including depreciation
 In this season VPS Worked = 200 days
 In this season OPS Worked = 188 days

7.3 Evaluation of The Two Technologies:

As already mentioned that the OPS units are "Cane Wasters" by comparison with mills, because of their lower recovery rate. This is a valid argument but clearly a very limited one, for the mills may equally well be dubbed "capital wasters" especially in seasons of low cane production. OPS units have a great appeal mainly on account of higher employment which is so much desirably for an economy like Indian, where labour is abundant and capital resources are very limited. If OPS Units as located in the backward areas with limited irrigation potential, cultivation of sugarcane can be encouraged as it ensures beneficial returns to the cultivators, besides providing regular employment throughout the year. When OPS units are also established in such areas, factory employment also gets generated. Thus when locations of OPS units are planned in the above manner, the direct and indirect benefits percolate to the weaker sections of the society through the provision of more continuous employment. Besides OPS unit help in narrowing the existing differences in the economic development of various regions of the country.

However, only a small proportion of the functioning OPS units are established in the backward regions of the country (See Table 7.1) and hence, the potential benefits does not accrue to the economy to

any significant extent. On the contrary, many units are situated either on the periphery or some times within the factory zones of the VPS mills. Such ill-planned locations have helped in accentuating the cyclical fluctuation of sugar production. In the years of excess availability of sugarcane, the OPS sector shortens their crushing operations leading to an excess production of sugar. On the other hand, in year of reduced availability of sugarcane, OPS units extend their crushing season and corner a large part of sugarcane supplies by offering higher prices to growers. As their sugar recovery is lower than VPS mills, sugar production is further reduced, accentuating the scarcities. Thus OPS units, located as they are, play a limited role in contributing to rural development.

Now it is necessary to see an evaluation of the disadvantage of higher manufacturing costs of OPS units and the measures needed to improve their competitive strength. In order to do this, it is necessary to identify the factors that gave fillip to their growth. Though technological improvement in juice extraction and crystal sugar manufacture opened the possibilities of producing sugar, the most potent factor that stimulated its growth was the policy of dual pricing*.² It may be remembered that after the

2. *The Price and distribution controls have been removed from August 1978 and reintroduced.

introduction of the dual price policy in 1966, two sets of prices prevailed in the market - a lower levy price and higher "free sugar" prices. As per this policy the Government compulsorily procured a certain quantum of sugar produced by sugar mills for distribution through fair price shops, known as "levy sugar". Because of the lower tariff value fixed by the Government and the lower excise duty, the prices of levy sugar were resultantly low. The VPS mills, after meeting the levy sugar obligations were allowed to sell the balance of their production in the open market and this was known as "free sugar". The price of such free sugar generally ruled higher. The OPS sector with no controls either on distribution or prices had one to compete in the high priced free sugar market. In this way the prices that prevailed during the last few years for free sugar provided enough margin to compensate for their higher manufacturing costs. This is evident from the data presented in the table 7.6. It is evident from this table that OPS sugar was generally quoted at lower price than mill sugar because of quality differences. Despite lower sales realisation, Khandsari units were able to operate viably as the ruling prices provided sufficient cushion to compensate for higher costs. The lower excise tariff on Khandsari sugar contributed to their capacity to compete in the open market.

Table 7.6

Open Market Wholesale Prices in Selected Markets for VPS & OPS

Year	Mill Sugar			Khandsari			(Rs. per quintal)
	Delhi	Kanpur	Hapur	Delhi	Kanpur	Hapur	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
1972-73	371	360	355	279.58	310.00	304.25	
1973-74	441	417	421	333.63	347.00	334.50	
1974-75	473	463	475	384.58	363.16	364.00	
1975-76	469	448	445	307.00	321.25	337.00	
1976-77	440	431	427	338.33	306.66	288.33	
1977-78	353	336	335	251.00	227.00	221.00	
1978-79	270	260	253	240.00	338.00*	214.00	
1979-80	554	525	514	526.00	500.00*	431.09	
1980-81	734	596	687	655.00	657.00*	664.83	
1981-82	536	520	530	514.00	511.50*	499.09	
1982-83	487	436	448	443.00	410.00*	355.00	
1983-84	477	474	470	471.00	428.50*	404.00	
1984-85	566	557	558	556.42	515.50*	469.17	

* Estimated Prices.

Source: ISMA, Vol. I Year 1984-85, New Delhi.

When we look a little back, in 80s, it was found that with the removal of all controls on sugar in mid-August 1978, the economics of OPS units underwent a change. The record production of 64.57 lakh tones of sugar in 1977-78 and the consequent fall in prices rendered the dual policy to totally recounited. The Government, therefore, decided to lift all controls on sugar prices and distribution. At the same time the factory prices of mill sugar was ruling at Rs.180 -185 per quintal. The market prices of ops sugar also fell in sympathy with mill sugar. The wholesale price of mill sugar was Rs.245 per quintal in Delhi and was Rs.242 per quintal in Muzaffarnagar while the wholesale prices of Khandsari were Rs. 205 per quintal. At this market price no unit was found economical to produce khandasari after paying reasonable prices to sugarcane growers. Taking into account the cultivation costs, a farmer has to be paid a minimum price of Rs. 10 per quintal.*³ With the existing recovery of 6.5 per cent, the cane costs for producing one quintal of sugar work out of Rs.153.80. If the purchase tax at the current rate of Rs. 10 per tonne is added, the sugarcane costs will amount to Rs. 168.98. If the processing costs of Rs.85 per quintal

3. *In Uttar Pradesh the VPS mill have to pay a minimum price of Rs. 12.50 and Rs. 13.50 per quintal to growers in eastern and western regions respectively in that current season. Similar prices are being paid by VPS mills in other states also.

are added, the total manufacturing cost works out to be Rs. 253.98. Given this cost structure, OPS units will not find it economical to produce sugar because the prevailing market price are below the manufacturing costs.

The Government was aware of this and has taken two immediate steps to improve the economic viability of OPS units in the country. The first step was the abolition of excise duty on sugar**.⁴ The excise relief, which is Rs. 10 per quintal alone is not sufficient to improve the competitive capability of OPS units, as their higher costs are not neutralised by the tax exemption.

The second measure implemented in some of the states is the fixation of a lower minimum price payable to sugarcane growers. It is reported that the Uttar Pradesh Government fixed a minimum price of Rs. 6 per quintal of sugarcane for OPS units for 1978-79 season. As conversion costs can not be reduced, the fixation of lower sugarcane prices may provide an immediate relief as the manufacturing costs of OPS units can be reduced to Rs. 177.28 per quintal of sugar. At the prevailing market prices of sugar, OPS units may well be in a position to operate with marginal or no profits by paying Rs. 6 per quintal for sugarcane.

4. ** The loss to the exchequer on account of abolition of excise amounts to Rs. 18.55 crores of the production level of 1976-77.

In this regard another point worth considering is the fact that while demand for Gur in the country is going down that for sugar has been increasing rather rapidly. As mentioned earlier the demand for white sugar in the country had increased at a rate of 4.2 per cent per annum where as demand for gur and khandsari taken together has recorded an increase of 0.43 per cent per annum only. Although breakup of demand separately for gur and khandsari is not available, the production estimates for khandsari indicated that the share of khandsari has been increasing and that of gur declining. Hence, it would be logical to compare losses in manufacturing sugar in OPS units vis-a-vis manufacturing of gur. As mentioned earlier in the manufacturing of gur hardly 60 per cent of cane juice is recovered. Any diversion of cane from manufacturing of gur to khandsari would be a welcome development. This would require that khandsari units should be encouraged through public policy.

Another point that needs careful examination is that VPS mills are not in a position to crush the entire cane produced in Uttar Pradesh. In fact only 1/3rd of the cane produced in U.P. can be crushed by VPS units. In future even if new factories are allowed to set up a quantum jump in the installed capacity of sugar industry cannot be achieved in a very short period. Thus in the coming decade even if

high priority is accorded for installing more sugar factories in Uttar Pradesh, a large part of cane would still not be crushed by the VPS mills. These VPS mills in order to produce more sugar would be required to extend their crushing period during the months of April, May and June. However, in that case recovery will go down.

Although the precise estimates from different experiments on the behaviour of sugarcane yield during different periods show varietal differences in sugarcane, agro-climatic conditions and time or planning etc. yet the results converge to the following: (a) the ratoon crop matures earlier than the planted crop; (b) over 80 per cent of total growth in weight and height takes place during the fifteen weeks of the monsoon, i.e. in October, the rate of growth falls to less than 10 per cent that of in the earlier 15 week period; and (c) after April the weight of cane start declining rapidly, depending of course on temperature and irrigation facilities.

As for sucrose development, rapid accumulation takes place during October to December; the rate of accumulation then falls during January to March. Peak recovery is generally reached in March after which it declines rather sharply. On the basis of conclusions of the research studies available on this topic, one can safely assume the following:-

(i) the yield of the ratoon, if harvested in the second fortnight of October, would be 10 per cent less than if harvested in December or later, and only 5 per cent less if harvested in November;

(ii) if harvesting is delayed beyond the end of March, then the cane yield would be lower than the optimum by 5 per cent in April by 10 per cent in May and by 20 per cent in June (to be on the safe side such amounts are assumed, otherwise the indications are that the decline in weight is rather sharper);

(iii) recovery in the second fortnight of October would, at the most, be three per cent point less and between one to two per cent point less in November as compared with that in March; and (iv) after March the sugar recovery would decline by at least one per cent point each month till June.

It is evident that late crushing is more disadvantageous to the nation than early crushing on account of the sugar foregone alone. The total national loss in the case of late crushing would be far greater if one were to add the extra irrigations required to keep the sugar cane crop standing till May or June and the opportunity cost of wheat or any other rabi crop foregone or the loss in the cane yield next

year, as the yield of rations of the late harvested crop is generally lower than of the ratoons of the cane harvested before mid-March. It can thus be concluded that in years of cane abundance it is far more advantageous from the national point of view to crush more cane in the early season than in the late season.⁵

From the above it is thus clear that even in VPS units if cane is crushed in May and June the sugar recovery level is unlikely to exceed 6 per cent. If this cane is crushed by OPS units during the optimum recovery period i.e. December to March the sugar recovery would be of the order of 6.5 per cent. Thus if a decision is to be made between the VPS units working in the months of May and June vis-a-vis OPS units, even from the point of view of sugar recovery one should prefer OPS units.

The chief reason for the higher manufacturing cost of Khandsari units, it was noted in chapter 6, is the poor recovery of sugar. If the technological research is directed to bridge the present gap of 3 to 4 per cent in recovery rates between large mills and OPS units the latter viability will improve considerably. Then OPS units can also operate in free market conditions with no or with minimal fiscal concessions.

5. Tyagi, D.S. "Sugarcane Output: Economics of Early Crushing", Economic Times, (December 8, 1981).

On the other hand there are so many problems attached with the VPS mills, in Uttar Pradesh. Despite the total number of sugar factories being more in the state than any other state, in production Uttar Pradesh stands second in India. The average quantity of cane crushed per day by the sugar factories in the state has been far less than their crushing capacity, not only during periods of short supply of cane but also in periods over production of cane, which is certainly a waste of limited resources of the state. The lesser utilisation of the capacity may be attributed to the fact that the plants in the Uttar Pradesh state are too old as a large number factories in the state were installed more than 50 years back. Hence, there are frequent break downs resulting in lesser crushing of cane even if cane is available at the factory gate in the required quantity. The second reason for the lesser utilisation of crushing capacity is the irregular supply of the required cane to the efficient VPS units. Two main factors are responsible for this. Firstly, operation of the factories is not confined to a compact area but is spread over a larger area, some of these being too far away to carry cane from fields to the factory gate at the appropriate time. Another factor responsible for irregular supply of cane is existing competition between sugar factories and other sweetening producing units. One most important reason for lower sugar recovery in this

state as compared to others like Maharashtra, Andhra Pradesh, etc., is that tropical climate is ecologically more suitable for the cultivation of sugarcane, as also for higher sugar recovery since temperature in these areas remains almost the same throughout the whole year but in Uttar Pradesh wide variation in temperature is witnessed. A significant portion of total cane in the state is usually crushed in the months of April, May and June which brings down sugar recovery level.

So there is immediate need for the modernisation and rehabilitation of old plants, especially of the factories which are not working properly. Even new factories require scientific management of manpower, which may go a long way in fuller utilisation of crushing capacity.

It is, therefore, necessary for evolving a sound sugar policy which is vital for both VPS and OPS and not only for the accelerated development of the economy and sugar production but also for the welfare of massive number of cane growers in the state, for those employed to the weaker sections hail from backward pockets of the state. For efficient and effective working of the sugar factories it is suggested that the top executives in cooperative and Government owned factories should necessarily be a well qualified technical hand, having requisite knowledge and experience of sugar technology, business

management etc. It is vital that these categories of factories must be managed as an entrepreneurial concern and the outlook of the people matter in the working of these factories, has to be oriented accordingly.

As far as Khandsari sector is concerned these are not getting any high advantage from Government side. The Government has been providing financial assistance to small scale industries. Although this sector comes under small scale industries these financial benefits are not given to them. If this is provided they could suitably modernise their plants and attain better recovery or even tide over their day to day financial problems.

Improvements in the power sector are essential for the overall development of the state. Once this goal is achieved even the OPS sector will be the beneficiary and costs will come down since power will be available to them and they can stop spending money on diesel and bagasse, as is presently the case. The Khandsari units certainly have a point with respect to the various Government departments which exercise direct or indirect control over them. At present there are 34 different departments which have some control over this sector. This procedure can certainly be rationalised. Besides this, it may have been a good policy to allow the cultivators to install a 'Khara Kolhu' to crush the sugarcane produced by him

and covert it to gur. But in actual practice the Khara Kolhu owners are purchasing sugarcane from the open market and even producing Khandsari. The Government must therefore, think of suitable ways and means to stop this malpractice.

If these measures to improve the condition of the Khandsari sector are taken it will not only prove beneficial to the entrepreneurs but will also increase the revenue for the Government provided better control is exercised on the sector.

CHAPTER 8

SUMMARY AND CONCLUSIONS

The purpose of this Chapter is to summarise the main findings and to assess methodological and policy implications of the study. It gives, conclusions and then offers some suggestions which may be of help to the policy makers.

8.1 Summary of Findings:

To produce one unit of sugar, OPS technology is superior to VPS technology in all respects but cane consumption. In OPS technology 16.55 units of cane is required to produce one unit of sugar as against 10.52 units for large scale technology. This difference, however, will be minimised when recent technological innovations are put into commercial use.

The main conclusion regarding comparative costs and employment levels for VPS and OPS units and their merits and demerits may be summarised as follows:

- A saving of Rs. 105.32 per quintal of sugar produced can be achieved in fixed capital if OPS khandsari units are promoted in the country specially in the state of Uttar Pradesh in place of large scale sugar mills (See 5.16).

- The labour input per tonne of sugar produced in OPS units is about 5 times that of large units. So OPS employ more mandays per tonne of sugar produced as compared to VPS mills (See 5.17).
- Production costs of khandsari units are higher by about 26 per cent as compared to those of large sugar mills (See 6.2).
- Value added per employee in khandsari unit is only 48.77 per cent of the large VPS mill. Share of value added in output is higher in the khandsari unit. Input costs in large scale sector are higher by 4.6 per cent and due to the higher pay scales and other benefits, the share of emoluments in value added is higher in large scale units (See 6.6).
- Higher costs per unit of sugar production in the case of OPS units is mainly due to their excessive use of sugar cane per unit of output. The higher consumption of sugarcane per unit of production is because of lower recovery rate of sugar which is 2 to 3.5 per cent point lower than that in the case of large sugar mills. (See Table 6.5).
- A part of the escalation of manufacturing costs of OPS units is also explained by their higher conversion costs.

- VPS units provide permanent employment to a larger proportion of their workers as compared to OPS units.
- Employees in the VPS sector receive emoluments which are higher than employees in OPS units. Larger output per manday and regulation of wages by statutory authorities have helped the employees in the VPS sector to secure better wages. (See 7.2 & Table 6.11).
- Capital costs are lower for OPS units but a social costs analysis has not demonstrated the superiority of the OPS over the VPS sector.

Small-scale production (OPS) has expanded rapidly in the Northern states of India, particularly in Uttar Pradesh, because the mills in Uttar Pradesh, obtain lower recovery rates and are handicapped by the fact that the length of the crushing seasons is uncertain and often short.

8.2 Methodological and Practical Implications in Technological Choice:

It could be concluded from the findings of this study that sugar mills should be set up in that part of the country, where recovery rates are high and crushing seasons long, with regular cane supply i.e. in states like Maharashtra. Khandsari units or small sugar producing units (OPS) should develop in the northern states of India, particularly in Uttar

Pradesh where length of crushing seasons is uncertain and often short.

As far as the requirement of sugar in the future is concerned, it is directly linked with the growth in per capita consumption. Keeping in view the rise in population and expected increase in income the demand for sugar is projected to increase to 138.44 lakh tonnes by the year 1995-96 and to 176.47 lakh tonnes by 2000-2001 A.D. The total requirement of sugar for domestic consumption and exports would be about 190 lakh tonnes. The demand will also jump in Uttar Pradesh from 14.22 lakh tonnes in 1990-91 to 31.80 lakh tonnes in 2001-2002 A.D. It is therefore in order to think that in meeting the requirements of the addition sugar, what role the OPS units and VPS units should play on which the pattern future development of sugar Industry would depend.

It is generally agreed that OPS units are "cane wasters" due to the lower sugar recovery rate achieved in these units, where as VPS mills are "capital wasters" as they require huge capital investment. The analysis presented in this study demonstrates the need for careful examination of all proposals for setting up of new mills, in the light of the existence of the small-scale technology and comparative advantages of this technology vis-a-vis VPS. The high capital costs would be reduced for larger sugar mills, if the sugarcane cycle could be stabilised. Investment in

new sugar mills would then become less risky than investment in OPS units. However, it is not possible to bring about a complete stabilisation in sugarcane production due to vagaries of weather, the nature of the market, etc. Thus, OPS units has a role to play in the future development of sugar industry.

Beyond the choice of technique in sugar production lies the more difficult choice of products. In sugar production in India there are alternative technologies resulting in similar, though not identical, products. The existence of another, very labour-intensive sweetening agent, gur, also derived from sugarcane, further complicates the question of the choice of products. It can be said that in a country like India where income per head is low emphasis has to be on a more equitable distribution of consumption goods rather than on producing high quality products such as sugar for consumption by the few. Hence, it may be preferable to produce twice the quantity of gur, which is cheap as well as a more nutritive food. In that case the argument would be that the labour intensive production of low grade sugar is preferable, on similar grounds to the capital intensive production of a lesser quantity of high grade sugar.

During the colonial era, the sugar industry was established behind a tariff wall. Possibly the consumption needs of either the metropolitan cities or

of expatriate community in India at the time played some part in the decision. Moreover, the forces of trade and commerce could not make this industry a highly successful commercial enterprise. Had there then been research on small-scale methods of production the industry might have developed differently. Besides that point, in past, there were other reasons for the continues expansion of capital intensive and large scale production without making any efforts to make small scale units more productive and efficient in technical scene. It can be argued that their was a wasted interest of professionals like chemists, engineers, accountants and managers in the country. These people were proud of modern technology particularly in view of the fact that sugar mill machinery was being produced in India itself. They have little interest in increasing production in small scale units at the expense of mill expansion.

Sugar Mills:

The competitive strength of the sugar mills is limited by restrictive Government policies. The economic health of these mills, is often effected by natural phenomena, such as floods, droughts, pests, insects, diseases on the one hand and competition from other sweeteners on the other. Due to this there has been wide fluctuations in production of sugar. Several mills in Uttar Pradesh are sick and some of

these have been taken over by the Government. Apart from heavy competition from other sweetening agents it is the mismanagement of mills that has been responsible for the rapid growth of the small scale sector (OPS). For setting up a sugar mills large amount of capital is required and for its management trained professionals are required as compared with OPS units.

Khandsari (OPS) Units:

The process of producing khandsari has developed from a very primitive technology and now through the open pan sulphitation system a better and high quality khandsari is produced with a relatively higher productive efficiency. In favourable circumstances the sugar produced in these small units is of the same technical standard (in terms of colour, size and dryness of the crystals) as average mill sugar, although it is generally not quite up to that standard specially in taste. But even to-day not all khandsari units are sulphitation units.

In Uttar Pradesh the OPS units are heavily concentrated in western region which is the dominant sugarcane growing area of the state. Although, there has been a declining trend in the total number of units but the total sugarcane crushed and consequently the production of khandsari has shown a considerable increase. The study brings out the fact that the OPS

units are generally old units. The Government policy has not been one of encouragement and so new licences are not normally issued except under special circumstances. OPS unit requires a low amount of capital for establishment as compared with large sugar mill and generate more employment opportunities.

8.3 Generalisation:

The advantage of any study lies in its in-depth analysis; its disadvantages in its lack of generality. However, certain generalisations are always possible and a study based on the cane processing industry is no exception. The result of this study that have a more general bearing are as under.

Data Collection

Economist usually carry out research on the basis of secondary data. The reliability of primary data is often questioned but such data often tend to be used in the absence of other feasible alternatives. This study is based on primary data collected personally through making field visits and secondary data collected from various publication. Experience made it very clear that it is very difficult to get reliable information from sugar mills and OPS units, particularly with respect to income and costs. Despite area being familiar it was most easy to get full co-operation from the selected units. It was my

familiarity with the areas and personal contracts that enabled me to get official accounts from OPS as well as VPS mills. The official accounts usually differ considerably from actuals, which are never shown. Apart from the accounts, it was also difficult to get reliable data on employment. Much more time than originally planned had to be spent to get correct employment figures. The most important lesson learned from the field work was that data pertaining to the OPS units should be used with utmost caution.

8.4 Conclusion And Suggestions:

On the basis of the above findings it is possible to draw some conclusions and offer suggestions which may be of some use in policy formulation regarding VPS and OPS units.

In country like India with a small proportion of the labour force engaged in the manufacturing industry, a shift to a more labour-intensive patterns of industrialisation can only have significant impact on the pattern of labour utilisation. This study assessed the scope for a labour intensive technology namely the open pan sulphitation process (OPS) to produce white sugar as compared to mill sugar (VPS). Labour Intensive technology in sugar industry i.e. OPS is suitable for a country like India, where labour force is large and capital resources are very limited. However, an immediate technological improvement is

required. Discussions with the individual units, revealed that technological research should be directed to effect immediate improvements in the following processes:

- A modern large crushing mill can extract about 95 per cent of the juice from sugarcane*. The corresponding maximum efficiencies with roller and hydraulic crushers used in the OPS sector respectively are 70 per cent and 80 per cent. Thus the juice extraction stage itself, OPS units loose substantial extractable juice.
- Improvements are also needed in the juice clarification and boiling sections. If the extracted juice is not clarified efficiently the recovery falls. In the present system of open pan heating, uniform heating is not possible as is the case in the vacuum pan process. This again reduces the recovery. Moreover, in the open pan method the juice is boiled to 108 degree to 110 degree celsius as compared to 60 degree celsius in the vacuum pan process and this effects the quality of sugar produced. The adoption of vacuum pan technology by the OPS units, therefore, would improve recovery levels.

*. The average extraction for the sugar industry was about 93.18 per cent in 1988-89. [ISMA, 1987-88, 89-90].

as well as quality of produce. For this, Government should give permission to atleast some of the OPS units on experimental basis to adopt mini vacuum pan in their units for a period of at least two crushing seasons. Indications are that positive results could be obtained.

- As OPS units are known as cane 'wastes' as compared with VPS mills, there is an urgent need to improve the efficiency of these units particularly in the field of juice recovery from the sugar cane. For this research on evolving appropriate varieties and on improving the technology is called for. No cost should be too high, for this research work.

When the above mentioned technical improvements are introduced, the sugar recovery efficiency can be raised to 7.5 to 8.5 per cent from 6.5 per cent at present level in the OPS sector. This will considerably reduce the disability of the OPS sector arising out the higher manufacturing costs and will enable it to stand on its own with marginal fiscal concessions like differential excise duties, exemption from purchase tax etc. The sooner the improvements are achieved, the better it could be as this sector can provide more employment through low capital investment.

When the state had a capacity to crush only about 34 per cent of the total production of cane and the production of sugarcane is showing an increasing trend, the khandsari unit do have an important role to play. Khandsari industry should not be treated as a competitive industry but supplementary to VPS. These units also acts as safety valve for the farmers particularly in the years of good production. Hence, a policy of dual development i.e. small scale (OPS) and large scale (VPS) side by side should be considered as appropriate for the future.

Appendix Table No. 1

Sowing Seasons for Sugarcane in Different States of the Country

State	Sowing Seasons	
	Adsali	Eksali
(1)	(2)	(3)
Andhra Pradesh	June - August	December - April
Assam	---	June - February
Bihar	---	February - March
Gujarat	---	October - November
Haryana	---	January - February
Karnataka	July - October	October - November
Kerala	---	February - March
Madhya Pradesh	---	January - March &
Maharashtra	July - August	July - November (a)
Orissa	August - September	September-February
Punjab	---	October - March
Rajasthan	---	October - January
Tamil Nadu	---	February - April
Uttar Pradesh		January - April
West Bengal	---	December - May &
Pondicherry		July - September (a)
		October - November,
		February - March
		October - March,
		October - November
		December - September

* Planting Continued for 6 months

(a) Special season

Source: Sugar Industry Enquiry Commission Report, 1974, Vol. 1, Part 11, Table No. 1.9, p. 662.

Appendix Table No. 2

**List of Sugarcane Varieties recommended for Commercial Cultivation
for the Sub-Tropical region of the country during 1986-87**

S.No.	Name of State	Early Ripening Varieties	Mid and Late Ripening Varieties
(1)	(2)	(3)	(4)
1.	Uttar Pradesh	C0395, C0S510, C0S687 C0S64, West and Central U.P.	C01148, C01158, C0S786, C0S758 C0S802, C0S767, C01347, C0S776 C0S770, C0S771, C06812, C062399, B017, B034, B070, B071, C01157, B054, C06911, C0S633, C0S718, C05767, C05776, C0S788, C05797, C0S802, C0S7918.
2.	Bihar	B043, B075, B090 B099, Cop2	B034, B070, B076, B084, B088, B089, B091, B0104, B0108.
3.	Haryana	COJ64, C06914, C07717	COL9, C0975, C01158, C01148 C07314, C0S767.
4.	Punjab	COJ64, COJ76, COJ78	COJ67, COJ46, COJ80, COJ83 COJ82, C01148, C062399

Source: Indian Sugar Year Book 1987-88 Vol. 1, pp. 46-48 from - Table No. 16.

Appendix Table No. 3

Value of Total Input use in Two Sugar Mills of Distt. Bijnor (1989-90)

S.No.	Components	(1)	(2)	(3)	(Value in Rs.)
			Unit I Dhampur Sugar Mill	Unit II Chandpur Sugar Mill	
1.	Sugarcane	56,23,37,747.00		7,63,04,400.00	
2.	All Chemicals used	3,87,81,528.00		51,23,845.00	
3.	Fuel	2,56,04,916.00		7,10,203.00	
4.	Depreciation	6,45,63,851.00		5,78,61,856.00	
5.	Other Expenses	11,99,96,627.00		50,73,216.00	
6.	Taxes	2,30,97,228.00		50,21,059.00	
7.	Wage & Salary	6,43,32,839.00		1,16,32,061.00	
	Total				
8A.	Including wage and salaries	89,87,14,736.00		16,17,26,640.00	
B.	Excluding wage and salaries	83,43,81,897.00		15,00,94,579.00	

Appendix Table No. 4

Value of Total input use in Ten Khandsari Industry (OPS) in Distt. Bijnor

(Value in Rs.)

Item	Unit I		Unit II	
	1988-89	1989-90	1988-89	1989-90
(1)	(2)	(3)	(4)	(5)
A. Raw Material Purchased:				
(i) Sugarcane	70,64,794	51,88,396	63,10,866	30,65,392
(ii) Sulphur	1,36,100	60,630	1,45,495	97,135
(iii) Lime	1,28,455	60,458	68,000	65,000
(iv) Oil	23,537	12,377	26,000	29,000
(v) Sujji (or Chemicals)	8,085	200	6,000	6,000
B. Fuel:				
(i) Electricity	3,91,952	2,50,999	90,073	61,501
(ii) Diesel	38,286	46,591	3,84,696	83,188
(iii) Bagasse (a) own	1,51,009	48,472	49,372	30,000
(b) Purchased	47,304	21,061	---	---
(iv) Fire Wood	---	---	---	---
(v) Coal	21,388	26,328	18,589	---
(vi) Any other	---	10,585	5,629	7,206
C. Rent if Any:	---	---	---	---
D. Miscellaneous Expenses	62,133	7,463	1,177	2,751
E. Other Expenses*	8,63,873	6,77,544	1,71,515	1,36,982
F. Taxes	1,00,000	1,00,000	1,38,270	82,346
G. Depreciation on plant and Machinery	1,00,000	1,00,000	52,328	21,398
H. Wage and Salaries	9,57,958	8,75,840	7,29,375	5,48,543
Gross Value of Input use	1,00,94,874	74,86,944	81,97,385	42,36,442

* Specify: - Gunny bags, Tins, Filter cloth, Interest paid to the Bank.

(Cont...)

(...Contd)

(Value in Rs.)

Item	Unit III		Unit IV	
	1988-89	1989-90	1988-89	1989-90
(1)	(2)	(3)	(4)	(5)
A. Raw Material Purchased:				
(i) Sugarcane	32,95,643	33,16,536	45,00,000	45,00,000
(ii) Sulphur	55,927	42,504	73,500	66,000
(iii) Lime	36,961	36,862	56,700	83,000
(iv) Oil	---	19,075	---	---
(v) Sujji (Chemicals)	---	---	---	---
B. Fuel:				
(i) Electricity	73,674	1,42,155	3,96,000	2,75,000
(ii) Diesel	1,34,902	1,03,659	1,79,000	46,000
(iii) Bagasse (a) Own	21,355	52,000	---	---
(b) Purchased	40,623	---	---	---
(iv) Fire wood	---	---	---	---
(v) Coal	---	---	---	---
(vi) Any other	---	---	---	---
C. Rent if Any	---	---	---	---
D. Miscellaneous	10,062	7,292	36,000	20,000
E. Other expenses	5,92,412	12,10,461	1,62,000	1,42,000
F. Taxes	50,662	67,601	2,00,000	1,50,000
G. Depreciation on plant and Machinery	66,081	1,07,824	2,34,000	89,000
H. Wage and salaries	2,75,022	4,46,032	6,73,000	3,88,000
Gross Value of input use	46,53,314	55,52,001	65,10,200	57,59,000

* Specify: - Gunny bags, Tins, Filter cloth, Interest paid to the Bank.

(Contd...)

(...Contd)

(Value in Rs.)

Item	Unit V		Unit VI	
	1988-89	1989-90	1988-89	1989-90
(1)	(2)	(3)	(4)	(5)
A. Raw Material Purchased:				
(i) Sugarcane	41,00,000	26,00,150	50,00,000	52,00,000
(ii) Sulphur	35,000	57,000	80,500	72,000
(iii) Lime	36,000	56,000	35,000	45,000
(iv) Oil	12,000	22,000	25,000	20,000
(v) Sujji (or Chemicals)	6,000	12,000	---	---
B. Fuel:				
(i) Electricity	2,91,200	1,90,750	2,20,000	1,10,000
(ii) Diesel	28,500	32,500	2,10,000	48,000
(iii) Bagasse (a) Own	35,000	35,000	60,000	60,000
(b) Purchased	30,200	16,000	40,000	40,000
(iv) Fire wood				
(v) Coal	18,200	23,500	---	---
(vi) Any Other	---	---	---	---
C. Rent if Any		6,500	---	---
D. Miscellaneous	45,500	5,400	38,000	23,000
E. Other Expenses	3,68,900	2,78,250	1,70,000	1,20,000
F. Taxes	1,00,000	1,00,000	2,10,000	1,60,000
G. Depreciation on Plant and Machinery	35,000	37,000	2,34,000	95,000
H. Wage and Salaries	6,57,200	4,00,150	7,00,000	4,60,000
Gross Value of Input use	57,98,700	38,72,200	70,22,500	64,53,000

* Specify: - Gunny bags, Tins, Filter paper or cloths, Interest paid to the Bank.

(Contd...)

(...Contd)

(Value in Rs.)

Item	Unit VII		Unit VIII	
	1988-89	1989-90	1988-89	1989-90
(1)	(2)	(3)	(4)	(5)
A. Raw Material Purchased:				
(i) Sugarcane	79,00,000	58,80,000	74,00,000	59,00,500
(ii) Sulphur	1,46,100	68,500	1,60,000	75,000
(iii) Lime	1,30,000	60,900	1,30,000	65,000
(iv) Oil	22,500	10,500	25,000	13,500
(v) Sujji (or Chemicals)	7,000	300	9,000	300
B. Fuel:				
(i) Electricity	4,00,200	2,20,000	3,90,000	2,50,000
(ii) Diesel	39,500	48,500	35,286	48,500
(iii) Bagasse (a) Own	1,00,000	40,000	80,000	50,000
(b) Purchased	38,900	22,000	40,000	22,000
(iv) Firewood	---	---	---	---
(v) Coal	15,000	20,000	20,000	25,000
(vi) Any Other				
C. Rent if Any	---	---	---	---
D. Miscellaneous	50,000	5,500	65,000	9,000
E. Other Expenses	2,85,000	1,45,500	5,40,800	3,93,000
F. Taxes	1,00,000	1,00,000	1,50,000	1,00,000
G. Depreciation on Plant and Machinery	1,00,000	1,00,000	50,000	50,000
H. Wage and Salaries	9,60,000	6,00,000	9,80,000	5,80,000
Gross Value of input use	1,02,94,200	73,21,700	1,00,75,086	75,81,800

* Specify: - Gunny bags, Tins, Filter paper or cloths, Interest paid to the Bank.

(Contd...)

(...Contd)

(Value in Rs.)

Item	Unit IX		Unit X	
	1988-89	1989-90	1988-89	1989-90
	(1)	(2)	(3)	(4)
A. Raw Material Purchased:				
(i) Sugarcane	43,00,500	47,00,000	48,00,500	27,00,500
(ii) Sulphur	1,00,000	1,40,000	34,500	56,500
(iii) Lime	1,00,000	1,39,000	35,500	55,500
(iv) Oil	15,000	19,000	12,000	20,000
(v) Sujji (or Chemicals)	4,000	5,100	5,500	11,500
B. Fuel:				
(i) Electricity	25,900	25,800	2,90,000	1,95,500
(ii) Diesel	40,000	50,000	28,000	32,000
(iii) Bagasse (a) Own	50,000	20,000	70,000	72,000
(b) Purchased	—	—	30,000	16,000
(iv) Firewood	—	—	—	—
(v) Coal	20,000	24,000	17,500	22,900
(vi) Any Other	—	—	—	—
C. Rent if Any				
D. Miscellaneous				
	50,000	59,000	42,000	7,000
E. Other Expenses*				
	4,10,000	3,39,500	2,59,700	1,43,800
F. Taxes				
	1,00,000	1,00,000	1,00,000	1,00,000
G. Depreciation on Plant and Machinery				
	1,00,000	1,00,000	2,00,000	2,00,000
H. Wage and Salaries				
	9,60,000	9,80,000	6,50,000	5,00,500
Gross Value of Input use		62,75,400	67,01,400	65,75,200
				41,33,700

* Specify: - Gunny bags, Tins, Filter paper or cloths, Interest paid to the Bank.

BIBLIOGRAPHY

Books

- Agarwal, R.N. Sugar Industry in India: My Recollections, Bombay Popular Prakashan, (1976).
- Ahluwalia, I.J. Industrial Growth in India-Stagnation since the Mid-sixties, Oxford University Press, London, (1985).
- Amin, Shahid, Sugarcane and Sugar in Gorakhpur: An Enquiry into peasant production for Capitalist Enterprises in Colonial India, Oxford University Press, (1984).
- Arthur, D. Bulter Labour Economics and Institution Growth Potential of Unions, Amrind Publishing Co. Pvt. Ltd., New York, London, (1975).
- Bagchi, A.K. Private Investment in India, 1900-39, Cambridge University Press, (1978).
- Baron, C.G. Sugar Processing Techniques in India, in A.S. Bhalla ed; Technology and Employment in Industry, ILO, Geneva, (1975).
- Baron, C.G. Technology and Employment in Industry, International Labour Office, Geneva, (1975).
- Bhalla, A.S. Technology and Employment in India: A Case Study Approach, ILO, (1975).
- Bhat, B.A. and Duguid, F. Appropriate Technology in Cane Sugar, Production, in Appropriate Industrial Technology for Sugar, UNIDO, New York (1980).
- Chandra, Bipin The Rise and Growth of Economic Nationalism in India, People's Publishing House, New Delhi, (1966).

- Carr, Marilyn The At Reader; Theory and Practice in Appropriate Technology, Oxford, Delhi Oxford University Press, Bombay, Calcutta, Madras, (1985).
- Chakravarty, S. Reflection on the Growth Process in the Indian Economy, Administrative Staff College of India, Hyderabad (1974).
- Fonseca A.J., Wage Issue in a Developing Economy The Indian Experience, Oxford University Press, Bombay, (1975).
- Gandhi, M.P. Problems of Sugar Industry in India: Scope and Prospect of Reorganisation in Post-War Period, Oxford University Press, Bombay, (1945).
- Ganpati Rao, S. The Indian Sugar Tariff, Bangalore Press, Bangalore, (1938).
- Ghosh, P and Santosh Nath Labour Relation in India, Sudha Publications, Pvt. Ltd, Bombay, (1969)
- Haan, HH de, Alternatives in Industrial Development: Sugar Processing in India, Sage Publication, New Delhi, (1988).
- Hirsch, V. Marketing in an Under-developed Economy: The North Indian Sugar Industry, Oxford University Press, Bombay, (1961).
- James, Feffrey Technology, Products and Income Distribution : A Conceptualisation and Application of Sugar Processing in India, ILO, (1977).
- Kaplinsky, R. Sugar Processing - The Development of a Third World Technology, ITDG, London, (1984).
- Khan, Moh. Arif Non-Wage Benefits in the Sugar Industry of Uttar Pradesh, Station Press Meerut, (1971).

- Minden Wilson History of Bihar Indigo Factories, Reminiscences of Bihar, The Calcutta General Printing Company, Calcutta, (1908).
- Mishra, G.P. Regional Structure of Development and Growth in India, in two volumes, Ashish Publishing House, Panjabi Bagh, New Delhi, (1985).
- Mishra, G.P. Some Aspects of Change in Agrarian Structure, Institute of Social and Economic Change, Bangalore, Sterling Publishers Pvt. Ltd., New Delhi, (1977).
- Misra, Kamal Kant Sickness in Indian Sugar Industry, Suneja Publishing Corporation, New Delhi, (1985).
- Roy, R.N. Sugar Industry in Dharbhanga Division, Capital Publication House, Delhi - 6, (1988).
- Sahai, R. Price Determination of Sugarcane and Its Payment in India etc, Oxford University Press, Bombay, (1971).
- Schumarcher, E.F. Small is Beautiful: A Study of Economics as if People Mattered, Radha Krishna, New Delhi, (1977).
- Sen, A.K. Employment, Technology and Development, Clarendon, Press, Oxford.
- Sen, A.K. Labour and Technology, in J. Cody, H. Hughes and D. Wall eds., Policies for Industrial Progress in Developing Countries, Oxford University Press, New York, (1980).
- Sen, Amartya Kumar Choice of Techniques and Aspects of the Theory of Plan Economic Development, 2nd ed. Oxford University Press, Bombay, (1962).
- Shah, N.J. History of Indian Tariffs, Thacker & Co. Ltd., Bombay, (1924).

- Sinha, Ram Vichav Sugar Industry in India, Deep and Deep Publication, New Delhi, (1988).
- Srivastava, S.C. and Singh, K.S. Pattern and Performance of Sugar Industry in U.P., Oxford University Press, Bombay, (1981).
- Tyagi, D.S. Farmer's Response to Agricultural Prices in India; A Study in Decision Making, Heritage Publisher, Delhi, (1974).
- Upadhyay, A.P. Profitable Utilisation of Sugar Factory Byproducts, Rajeev Sadan Publication, New Road, Ratlam, M.P., (1969).
- Van, Royen and Bengtson Fundamentals of Economic Geography; V. Edition, Prentice Hall of India, Pvt. Ltd., New Delhi, (1969).

Articles

- Alpine, R. and Pickett, J. "More on Appropriate Technology in Sugar Manufacturing", World Development, Vol. 8, (1980).
- Barbar, A.C. "Studies in Indian Sugar, Bot Ser. VIII(3) (memorandum to the development of Agriculture India.
- Basu Sanjaya "Sugar from One Crisis to Another, The Economic Times, (Calcutta) (September, 25, 1978).
- Bedi, Suresh "Government Policies and Growth of Industry since 1900" Productivity, Vol. 22, (October - December 1981).
- Commander, Simon "Proto-Industrial Production as a Barrier to Industrialisation? A Case Study of North Indian Sugar Industry - 1950-1980". Capital, Vol. 20 No. 12 (March, 23, 1985).
- Delasanta, D.W. and Morgan, R.P. "The Choice of Sugar Processing Techniques for Pakistan", World Development, Vol. 8, (1980).
- Deshpandey, V.V. "Role of Khandsari in Sugar Industry", The Economic Times, (28th November, 1985).
- Dhar, Banshi "Problems and Prospects of Sugar Industry", Indian Sugar, (22, 4 July 1972).
- Encarnacion, J. "On Appropriate Technology Saving and Employment", Journal of Development Economics, Vol. 1, (1974).
- Forsyth, D.J.C. "Appropriate Technology in Sugar Manufacturing", World Development, Vol. 5, (1977).
- Forsyth, D.J.C. "Appropriate Technology in Sugar Manufacturing, a reply, World Development, Vol. 8, (1980).

- Franklin M. Fisher "The Existence of Aggregate Production Function", In Econometrica, (New Haven, Conn,) Vol. 37, No. 4, (October, 1969).
- Hagelberg, G.B. "Appropriate Technology in Sugar Manufacturing - a rebuttal, World Development," Vol. 7, (1979).
- Iqbal, Badar Alam "Sugar Industry in Crises", Yojana, Vol. 25, No. 4, (January - March 1985).
- Iqbal, B.A. and Salah-uddin "A Valuable Foreign Exchange Earner", Yojana, Vol. XXI, No. 6, New Delhi, April 15 to 30, (1977).
- Kumar, A. "Sugar Industry and Government Intervention", Economic and Political Weekly, Vol. 15, (1980).
- Kumar, Arun "Buffer Stock: Another Burden on Consumer" Economic and Political Weekly, (August 21, 1982).
- Kumar, Arun "Sugar Policy: Need for New Approach," Economic and Political Weekly, (July 24, 1982).
- Mehra, O.P. "Sugar Output: Danger Signals", Hindustan Times, New Delhi, (October 17, 1981).
- Mehra, O.P. "Sugar Industrial Policy", Hindustan Times, New Delhi, (September 7, 1981).
- Narayan, Pradeep "Problems and Prospects of Sugar Industry", Indian Sugar, (August 1975).
- Negi, Y.S. and Grewal, M.S. "Trend in Inter State Sugarcane and Sugar Production in India", Capital, Vol. 26, (2, April-June, 1981).
- Puri, D.D. "Problems and Prospects of Sugar Industry" Capital, (February 15, 1982).

- Rangarajan, C.
and Karlo, A.H. "Choice of Technology in the Sugar Industry", Economic and Political Weekly, Vol. 15, (1980).
- Raghavachi, Vimal "The Sugar Factory and Rural Development", Productivity, Vol. No. 1, (April-June, 1982).
- Rayudu, C.S. "Co-operatives in Sugar Industries", Yojana, 1-15, Vol. 26, No. 4, (March 1982).
- Roy Chaudhary, P.C. "Last Days of the Indigo Planters", The Times of India, (February 6, 1977).
- R.P. Humbert "Sugarcane Byproducts as Crop Bossters", International Sugar Journal, Sugar News (Philippines), (1975).
- Sawhney, J.B. "Problem of Low Sugar Recovery and Low Sugarcane Yield in Northern India and Remedies for Improving the Same", Indian Sugar, Vol. 23, No. 1, (April 1973).
- Sen, A.K. and Dutta Chowdhary, M. "Durgapur Fertiliser Project: An Economic Evaluation", Indian Economic Review, Vol. V, No. 1, (April, 1976).
- Singh, V.P. and Kairon, M.S. "Constraints and Remedies", The Economic Times, (November 28, 1985).
- Srivastava, R. "Economic Interpretation of Sugar Crop Experiments", Lib, No. 17, (April 1982).
- Tyagi, D.S. "Sugarcane Output: Economics of Early Crushing", Economic Times, (December 8, 1981).
- Vidya Sagar, "Sugar Crisis in India: Proper Direction Needed", The Economic Times, Calcutta Edition, (July 8, 1985).

**Occasional/Technical/Working Papers,
Government and Other Publications**

- | | |
|---------------------|---|
| Government of India | : Interim Report of the National Commission on Agriculture and Fertilizer Distribution, Ministry of Agriculture, New Delhi, (1971). |
| Government of India | : Report on Survey of Labour Conditions in Sugar Factories in India (1962), Labour Bureau, Ministry of Labour Employment and Rehabilitation, New Delhi, (1962). |
| Government of India | : Report 1972-73, Vol. I, Ministry of Labour and Rehabilitation, Department of Labour and Employment, New Delhi. |
| Government of India | : Report of the Second Wage Board on Sugar Industry, (1970). |
| Government of India | : Report of Sugar Enquiry Commission, (Chairman Dr. S.R. Sen) (1965). |
| Government of India | : Report of the Committee on Rehabilitation and Modernisation of Sugar Factories, (Chairman Mr. S.N. Gundu Rao) (1965). |
| Government of India | : Report of Sugar Industry Enquiry Commission (Chairman - Justice Mr. V. Bhargava). |
| Government of India | : Tariff Commission Report, Bombay (1973). |
| Government of India | : Tariff Commission, Report on the Cost Structure of and Fair Price Payable to Sugar Industry, (1974). |

- Government of India : The Economic Survey, Government of India, (1985-86), Ministry of Finance, Delhi.
- Government of India : Report of the Committee on Controls and Subsidies, (Chairman Mr. V. Dagh) (1979).
- Government of India : Agricultural Prices Commission, Report on Price Policy for Sugarcane for the 1980-81 Season (1980).
- Government of India : Report of the Special Expert Committee on Cost of Production Estimates. (Chairman Dr. S.R. Sen) (1980).
- Government of India : Agriculture Prices Commission, Report on Prices Policy for Sugarcane for the 1981-82 season (1981).
- Government of Maharashtra : Sugarcane Cultivation in Bombay State Issued by the Directorate of Publicity, Government of Bombay, Bombay, (Sugarcane Research and Development Section of the Bombay State, Development of Agriculture). (1957).
- Government Publication : Indian Sugar Supplement (1948).
- Government Publication : Indian Sugar (July 1973).
- Government Publication : Indian Sugar Year Book, Indian Sugar Mill Association, New Delhi, (1977-78).
- Government Publication : The Indian Famine Year Book, (1936).

- Government Publication : The Indian Sugar Mills Association, New Delhi, 110 019, Indian Sugar, Vol. 31, No. 6, (September 1981).
- Government Publication : Indian Sugar Year Book, 1983-84, Vol. 1, Indian Sugar Mill Association, Sugar House, 39, Nehru Place, New Delhi.
- Government Publication : Indian Sugar Year Book, 1984-85, Indian Sugar Mill Association, New Delhi.
- Government Publication : Indian Sugar Year Book, 1987-88, Vol. 1, Indian Sugar Mills Association, New Delhi.
- Government Publication : Indian Sugar Year Book, 1988-89 and 1989-90, Indian Sugar Mill Association, New Delhi.
- Government Publication : The National Federation of Co-operative Sugar Factories Ltd., New Delhi - 110 019, Co-operative Sugar, (April 1986), Statistics Section.
- Government Publication : "The World's Sugar Supply; It's Sources and Distribution", National Bank of Commerce, (December 1917).
- Government of U.P. : Main Statistics of Sugarcane and Sugar Industry of Uttar Pradesh (July 1985).
- Gustav Mikusah : "Sugar: Encyclopedia of the Social Sciences, Vol. XIV (The Macmillan Company, New York).

Mishra, G.P.

"Policy for Science and Technology for Developing Traditional Industries in Backward Areas: Problems and Prospects", Working Paper No. 36, Giri Institute of Development Studies, Lucknow.

Mishra, G.P.

"On the Question of Relationship Between Agricultural Surplus and Economic Development", Working Paper No. 91, Giri Institute of Development Studies, Lucknow.

Planning Commission

"Draft Five Year Plan 1978-83, New Delhi (1978).

PRAI

"Report of the Forth Technical Seminar on the Open Pan Sugar Manufacture, Planning Research and Action Institute, Lucknow, (24-26 September, 1966).

Singh, R.P.

"Build up Diseases in Heat Treated and Untreated Seed Cane, I.I.S.R. Tech. Report A.I.C.R.P. on Sugarcane for (1981-82).

Tyagi, B.N.

"Sugarcane Economy of Uttar Pradesh", Occasional Paper 2, CADR, Lucknow, (1989).

Tyagi, R.C.

"Problem and Prospects of Sugar Industry in Uttar Pradesh", Working Paper No. 75, G.I.D.S. Lucknow.

UNIDO

"Appropriate, Industrial Technology for Sugar (Monographs on Appropriate Industrial Technology, No. 8, 1980), New York.

UNIDO/UNEP

Final Report of the Joint
UNIDO/UNEP Seminar on the
"Implication of
Technology Choice in the
African Industry", 18-22
April, (1977), Nairobi
(mimeo).

UNIDO

"Guidelines for Project
Evaluation", UNIDO, New
York (1972).